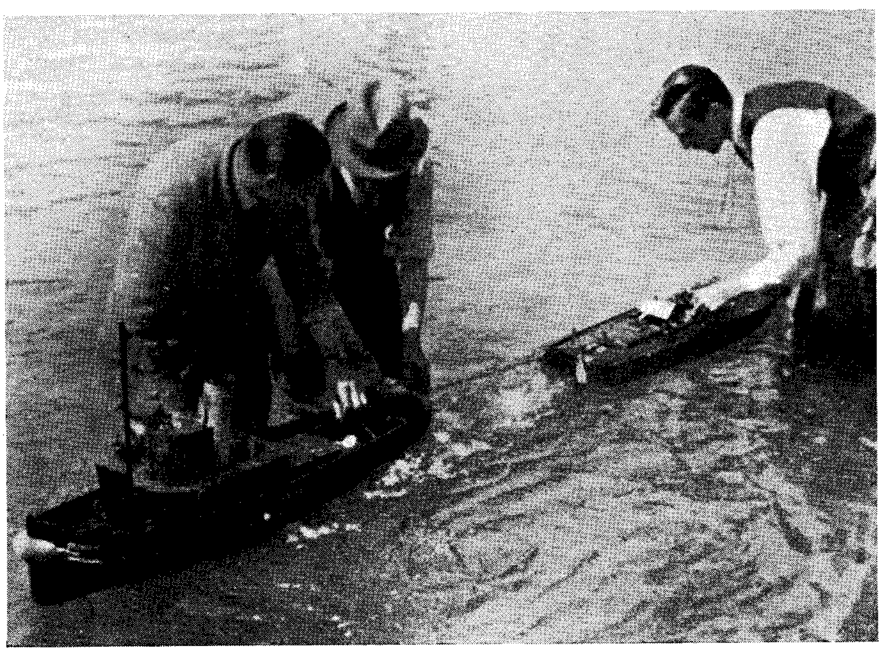
The Novice Dabbles—In Boats

# THE MODEL ENGINEER

Vol. 82 No. 2029 • THURS., MARCH 28, 1940 • SIXPENCE

## In this issue





"TUG-O'-WAR"

**The rival merits of steam and internal combustion engines as a means of propulsion are often hotly disputed among model engineers, and the question is being put to the test here between Mr. Woodhouse's tug *Ruman* and Mr. Walker's motor launch *Coron*. Which won the tug-o'-war? Well, what do *you* think?**

THE MODEL ENGINEER

Vol. 82 No. 2029 March 28th, 1940

60 Kingsway, London, W.C.2

# Smoke Rings

### That "Rutland Grange"

THE publication of the photographs on page 195 of our issue for February 22nd last, has caused some readers to send us drastic criticisms of the $3\frac{1}{2}''$ gauge "Rutland Grange" illustrated there. Without exception, the critics point out various features that are incorrect, or are different from standard G.W.R. practice; and, while there may be ample justification for these criticisms, there is one important aspect of the matter that seems to have escaped the notice of our correspondents, and was specifically mentioned by "L.B.S.C." in his reference to the engine. It is that the builder had only once before made a locomotive; "Rutland Grange," therefore, is his second attempt. If we add to this the fact that, unlike all the angry critics, "Rutland Grange's" builder lives far from G.W.R. territory, we begin to realise that, so far as appearance and general details are concerned, he has not made so bad a job of it after all. We have seen much worse specimens turned out by people who really ought to know better. Apart from all this, there is the fact, duly recorded, that "Rutland Grange" is an excellent worker, and, as such, she can give much pleasure to all who see her working, as well as achieving what was probably the chief purpose of her construction. To the enthusiastic builder of small locomotives, success on the track is the first consideration, especially with the early attempts; the study of accurate details develops as time goes on. Early successes serve as stimulants to further efforts; and, unless we are much mistaken, there is no reason why "Rutland Grange" should not be followed by further and better locomotives in which progressive improvement in detail and general appearance will be noted. Everything must have a beginning, and perfection cannot be attained at the start, nor even in a second attempt. To condemn a good piece of work simply because it does not look right is being a little too sweeping. G.W.R. enthusiasts, surely, can find some satisfaction in the fact that a reader, who lives well outside G.W.R. territory, has chosen one of that Company's locomotives for a prototype, and they should encourage further efforts. We do not wish to disparage criticisms, provided that they are of a constructive nature; and there are few model engineers who would not be glad to know when they have made mistakes, or who would not welcome advice or information that would be helpful in rectifying errors. But destructive criticism, usually, is discouraging, and is not consistent with the true spirit of our craft.

* * *

### Thursday, February 29th

SEVERAL readers responded to the hint given under the above heading in our issue of February 29th. The truth is that this interesting combination of day and date occurs once every twenty-eight years. There was a Thursday, February 29th, in 1912, and there will be another in 1968 and again in 1996. The former has been confirmed by re-consulting the files of THE MODEL ENGINEER, the previous cursory glance having failed to disclose it. Let us hope that by 1968 something like settled peace will have been restored to all the world in general, and to model engineering in particular !

* * *

### A Show of Ship Models

I AM informed by Mr. Adrian L. Silas that he is organising a show of ship models and items of naval and nautical interest, to be held on behalf of the comforts fund for the Navy, probably about the middle of April. He has been promised some influential support and a certain number of interesting exhibits. He is anxious, however, to procure a few more ship models, and would be glad to hear from any of our readers in the London area who could contribute something of interest on loan. The show will be held in the Kensington premises of Messrs. Derry and Toms, and will remain open for about three weeks. No charge for admission will be made, but voluntary contributions to the fund will be welcome. All expenses for carriage and insurance of loan models will be paid by the organisers. Mr. Silas is himself a ship modeller; his address is 5, Temple Sheen Road, East Sheen, S.W.14.

Percival Marshall

# Coal-Fired Flash Boilers

**A description of the construction and performance of an unusual form of steam generator for model locomotives**

**By N. Dewhirst**

SOME readers of THE MODEL ENGINEER may remember that in the issue of September 9th, 1937, I described the coal-fired water-tube boilers fitted to my $2\frac{1}{2}''$ gauge 0-6-2 tank, and 4-6-0 express locomotives.

Having satisfied myself that the coal-fired water-tube boiler can give satisfactory results, I decided to try a coal-fired flash boiler on the 4-6-0 locomotive.

I have made many types of boiler, but have never before made a flash boiler for any purpose, and ever since I first saw an account of a trade model loco. fitted with this type of boiler, in THE MODEL ENGINEER in 1910, I have always desired to try one out, and having followed with keen interest all flash boiler notes published in recent years in THE MODEL ENGINEER, I made a start on the conversion. It meant a good deal of alteration, but I am glad to say the flash boiler has proved to be quite satisfactory.

The safety, and simplicity appeal to me, with the entire absence of flat surfaces, stays, and the many constructional joints of the normal boiler, and in working, no attention to water level required, with the maintenance of a water gauge, with its glands, in a reliable condition, whilst the construction of the pressure tank is simple.

The cylinders of this locomotive are the same as first fitted 17 years ago, and are of hard bronze, and were made without a lathe.

Consideration was, therefore, given to the final temperature of the steam in arranging the flow of water and steam through the boiler. Hand forced lubrication is relied on and so far no trouble has been experienced.

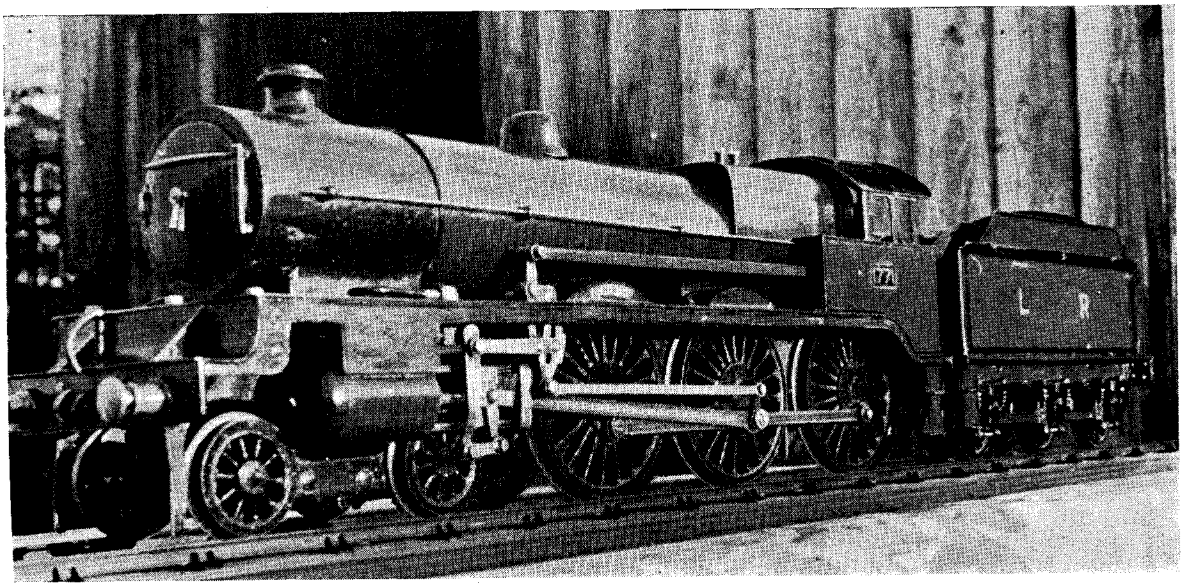
The boiler casing is lined internally with asbestos, 5/16" thick, thinned to $\frac{1}{8}''$ thickness at the firebox sides in order to obtain the necessary width of firebox.

I will describe the system from the water in the tender to the final supply of steam to the cylinders.

In the rear of the tender is the open water tank, in which is fitted a hand feed pump. Water is fed (via a cock controlled by a dummy brake handle to isolate pump in case of leakage) to the bottom of a pressure tank situated in front of the open tank, and compresses the imprisoned air above the surface of the water. It was found, however, that at the desired working pressure, the air capacity was too small, and an additional air tank was fitted in the open tank, and connected by a $\frac{1}{8}''$ dia. pipe from the bottom of the extra tank (so as to force out any water that may enter) to the top of the water pressure tank. A cycle air-valve is fitted to the extra tank for the purpose of charging this with air.

A branch is taken off the feed pump line to the pressure tank, and water from the pressure tank is taken direct to the boiler.

A check-valve body is included in the pipe from




**General view of coal-fired flash-boilered model locomotive.**

pressure tank in case of surging, but the ball-valve has never been inserted, and no surging trouble has been experienced.

A safety-valve was also fitted on the boiler side of the check body, as would be necessary if a check had been fitted to limit the maximum pressure in the boiler with shut regulator, but as this valve gave trouble from leaking (although it had been perfectly satisfactory as a steam safety-valve) it was removed, and a plug fitted. Therefore, as there is no check valve, the boiler is always open to the pressure tank, and the boiler pressure cannot exceed that in the tank. No mechanical pump has been fitted at present.

A pressure gauge is fitted on the feed pipe.

The feed connection to the boiler is made above the draw beam, and under the foot plate, so that the boiler can, if necessary, be withdrawn from the back plate.

From this connection the boiler coil starts, and passes through the back plate, below, and to the right of the fire door, and then turns up inside the back plate, to the top of the boiler casing, and proceeds to the smokebox end. It then takes 20 turns inside the barrel portion towards firebox until the throat plate is reached. Then it is taken once over the combustion chamber, and down to bottom of firebox (this to form a clip of the tube itself) and three turns round firebox (above grate level). It is then spaced at the firedoor end for firing, and taken four times round upper part of the combustion chamber, and is then led to the regulator manifold, and from this a zig-zag superheater is taken to the cylinders.

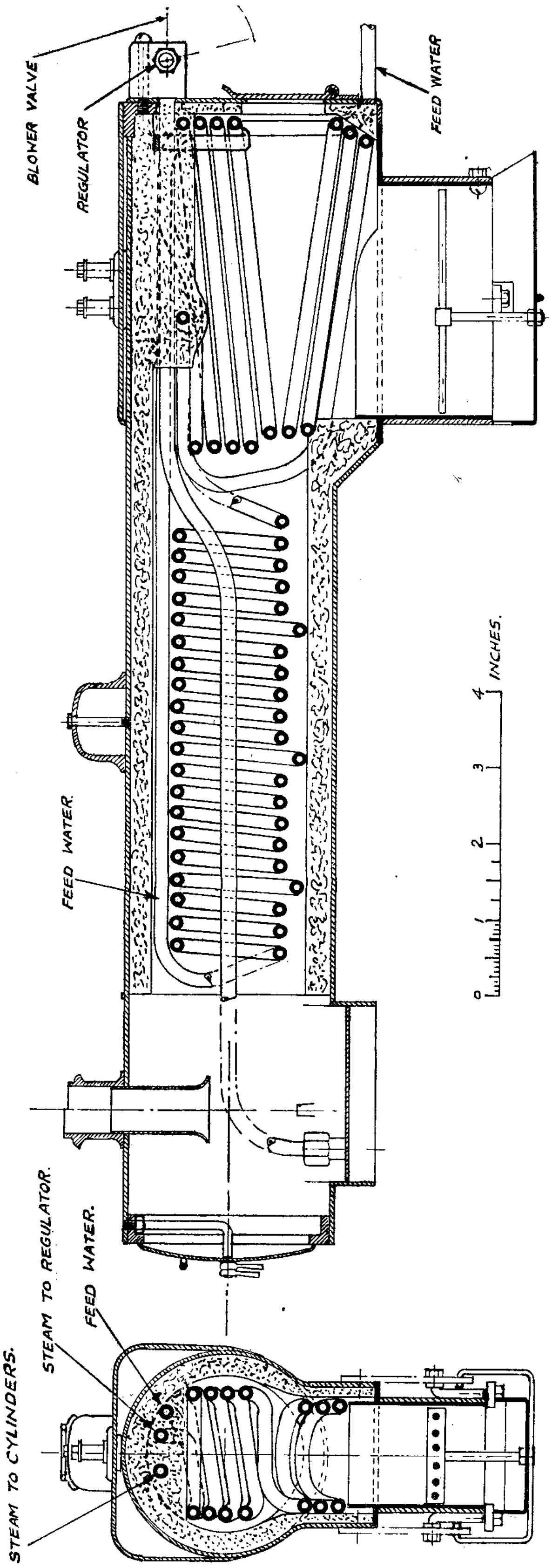
The blower valve takes steam from the regulator manifold.

The object of taking three turns close to the fire following the heater portion in the barrel was to pick up extra heat during periods of dull fire, or careless firing; also, by taking steam from the upper coils it was thought that superheat would not be so high during periods of bright fire.

I am indebted to my friend Mr. W. Robertson, for his suggestion, to arrange the firebox coils as just described. Mr. Robertson, by the way, has completed a fine $2\frac{1}{2}''$ gauge model of the L.N.E.R. "B 12" class locomotive, to which he has fitted a coal-fired water tube boiler, which gives excellent results, described in "M.E." for Dec. 7th last.

Actually, it was thought wise to drop the grate to the position shown on the drawing, as the lower coils could easily be made red hot when first tried at a higher level. The position of the grate, and the lower fire box assembly is now precisely as when the water-tube boiler was fitted.

The boiler tube is 3/16″ outside dia. by 18 gauge thick, solid drawn copper tube, and there is about 17′ 6″ of tube in the boiler portion. I was not able to obtain longer lengths than 11′ 0″. The two portions were joined by a copper sleeve joint and silver-soldered, and by coiling the boiler from the regulator end this joint was found to occur about halfway along the barrel, and well away from the fire.




**Longitudinal section of coal-fired loco. flash boiler.**

The regulator manifold was cut from solid brass. The regulator is a needle-valve arranged with the spindle across the back plate with the handle on the left hand side, and down in the shut position, and, therefore, has a pull back movement to open. The valve is screwed 3/16″ Whit. which provides sufficient opening.

The blower valve is arranged centrally, and the steam conducted via an external pipe to the smokebox. A branch is taken to the lower right corner of the cab, and provided with a cock for attachment of auxiliary blower for steam raising.

A pressure-gauge was at first fitted to the right-hand end of the regulator manifold, but was discarded, as the syphon was found inadequate

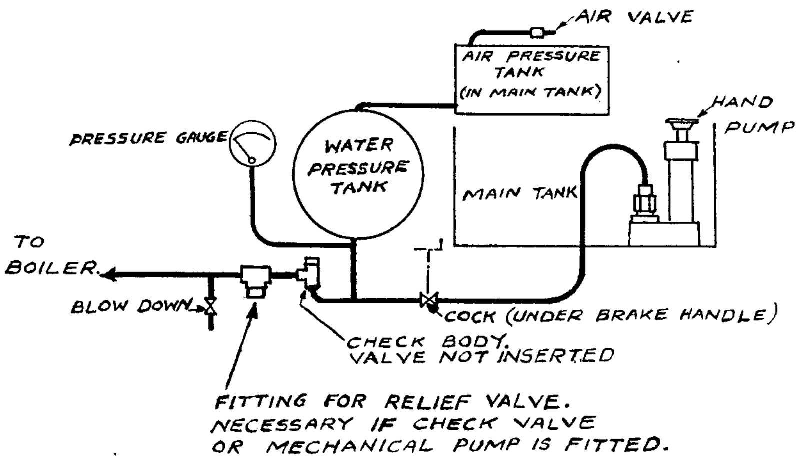



**Diagram showing feed system of coal-fired loco. flash boiler.**

and consequently the gauge suffered from the effect of hot dry steam.

All silver-soldering was done over a gas ring, with the exception of the tube joints in the regulator manifold, and because it was impossible to direct the flame satisfactorily for this job, a friendly garage manager allowed me to do this job on his gas forge.

To return to the tender. The pressure tanks, of course, must be made to stand working pressure, and these are constructed of solid-drawn brass tube, with flanged ends riveted in and fitted with centre stays, and caulked with soft-solder. No heat, of course, reaches these tanks. The water pressure tank is 2⅛″ dia. by 3½″ long and 1/16″ thick, fitted with 3/16″ dia. centre stay. The air tank is 1½″ dia. by 4″ long and 20 gauge thick fitted with ⅛″ dia. stay.

The coal plate covers all tanks, and the air valve connection is under the water filler lid. The only difference apparent from the normal tender is a pressure gauge in the left-hand front corner.

The system is started up as follows :—The whole system is dry except the open tender tank.

The firebox is filled with charcoal and a " Meta " fuel tablet ignited in the ash pan. Then, with regulator and blower valve shut, air is pumped with a tyre pump into the air connection on the blower pipe, the cock, of course, being opened. This gives intermittent blasts to the blower, but in four or five minutes the fire can be drawn up to a working state when anthracite can be fed.

Next, water is fed by hand pump to the pressure tank until 20 lb. per sq. in. shows on the gauge.

The auxiliary air cock is now shut, and the steam blower opened, which allows water to enter the boiler and steam is generated immediately.

The tyre pump is now connected to the air tank and pressure increased to about 50 lb. per sq. in., the blower being shut down as required.

The hand pump is now operated to feed extra water to the water pressure tank to raise pressure to the desired working pressure. I usually run up to 90 lb. per sq. in. at the most.

The cylinders may now be warmed up and the loco started. When the pressure falls to about 60 lb. per sq. in. the hand pump is used to replace water consumed, which also restores air pressure above the water.

The boiler is by no means tricky to handle, and the fire is easily maintained at a suitable intensity. At first I was inclined to run too fiercely.

The boiler was deliberately flooded on the second run in order to see how low the fire could be allowed to burn. On shutting off, however, and giving a small blower opening the boiler dried out, and restored normal working.

Since then I have run many times, and have had no signs of flooding.

The steam is certainly very dry, and hot, but I do not think the superheat is excessive. The exhaust is quite dry, but is visible in cold damp weather.

The coal and water consumption is very light. There is, of course, no loss due to safety valves blowing off, and blowing down water gauges.

The top part of the boiler barrel gets hotter than when fitted with water-tube boiler, as the inner barrel used to keep temperature down at this point, but the paint is quite unaffected, whilst the lower part of the firebox is probably not so hot, as the fire is run less intense. I have also removed a restricting nozzle from the blast pipe.

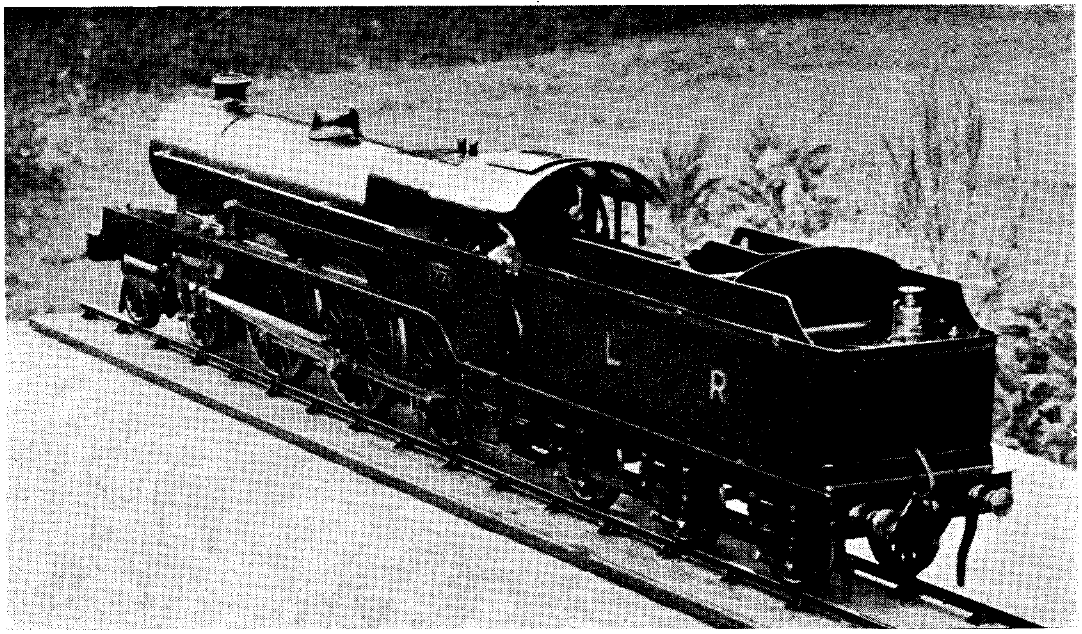
The only objection I might make is that the controls get somewhat hot, as, of course, they deal with superheated steam. Suitable " cool handles " could be fitted if desired.

The absence of pressure and water gauges in the cab is not very apparent, as it is not necessary to remove the cab roof for driving or firing.

The feed pump is used about every 5 to 7 minutes, and usually restores pressure from 60 to 80 lb. per sq. in. in about 45 seconds.

When standing, or running, the pressure gauge needle does not flicker in the slightest. There is no surging whatever.

The locomotive is a passenger-hauler, but I



**Three-quarter rear view of coal-fired flash boilered model locomotive.**

make no claim to exceptional hauling power. The cylinders are only $\frac{5}{8}''$ bore by $1''$ stroke, which is small to modern standards, whilst the grate is only $3\frac{1}{8}''$ long by $1\frac{1}{4}''$ wide, and, of course, the boiler is really quite small. About 20 stone is all I can cram on my passenger trolley, and it can haul this load.

The valve events are not as good as they could be, I think there is a little too much lead and compression ; however, the loco. is fairly economical, and its starting under difficult conditions more certain than with the water-tube boiler. Perhaps this is due to dry steam at all times, as there is no suspicion of priming or moisture in the exhaust. A friend has said he could see no difference in running from a normal boiler.

The weight is about the same as before converted, but slipping does not occur so easily when starting, due, I think, to the more gradual regulator action.

I am quite satisfied with this boiler, and if I were to build a new model loco., I should certainly fit another flash boiler, and from what I learn of copper flash boilers, they have a long life. Starting up may sound complicated, but it can be done without assistance.

I do not wish to make comparisons with other types of boiler. The fire-tube boiler is, of course, the correct type, and any visitor to the MODEL ENGINEER Exhibition will know what a fine performance this type can put up, but I think the flash boiler has many points in its favour, especially the ease with which an almost indestructible boiler can be made. My own " workshop" consists of a portable bench, whilst the complete equipment of hand tools are contained in a box measuring $1' \, 10'' \times 11'' \times 5''$ deep. It has the advantage that I can take it to almost any convenient position in which to work.

I have had no experience of rustless-steel tube, but I would think this material could be used instead of copper ; though, probably, more difficult to handle.

I should have mentioned that the copper tube was annealed before coiling, and also that a blow-down cock is fitted in the feed pipe, as indicated in the diagram of the water system.

This discharges by means of a hose into the main tank when shutting down.

Also, that, although the furnace portion of the firebox in this boiler is not asbestos lined, it does not show red hot at any time, even when viewed in the dark. The boiler and firebox casing is brass, and the liner inside furnace portion is sheet iron. I fitted a new sheet iron liner when converting to flash boiler ; the previous one had been in service in the water-tube boiler for several years. This liner is easily and quickly renewed, and is secured by one bolt only.

Some readers, when looking at the photos, may be puzzled by the inclination of the expansion links in relation to the main crank-pins, for an engine with outside admission slide valves, as is obvious from the combination levers. This is due to the return cranks being set 90° in retard of the crank-pins, the radius rods being at the top of the links for forward gear. The reversing wheel has an ordinary right-hand thread, and is turned to the right for forward gear, although the nut is, of course, at the rear of the " cut-off " slide. The return cranks could have been set 90° in advance of crank-pins with the same cab arrangement if the weigh-shaft had been assembled with the lifting arms to the rear, and thus lower the radius rods to bottom of links for forward gear, but this arrangement was not convenient when the engine was first built.

# The "Bat"

By "L.B.S.C."

## Boilers

AS some good folk prefer the loco-type boiler and others the water-tube pattern, maybe it would be as well if I describe both boilers "in parallel," as Miss Milly Amp would say. There is not a wonderful lot of difference between the outer shells of each type, and most of the fittings are the same, so we can save time and space anyway. In case any tyro builders are in doubt as to which type to adopt, here are a few pros and cons, so they can make their own choice. The loco.-type boiler is a simplified copy of the actual full-sized locomotive component, and is fired with a shovel. Whilst there is more work in it than the water-tube pattern, the work is not in any way more difficult; and the realism, both in appearance and performance, amply compensates for the few hours' extra work spent in construction. Properly fired, the boiler is extremely sensitive to the demands of the engine under all conditions of working, e.g., when the locomotive starts to climb a bank, and the blast sharpens up, the fire immediately glows brighter, gives out extra heat, and supplies the steam required. Drifting downhill, or running slowly on the level, the fire dies down a little, and steam generation is suited to the needs of the moment. Cost of fuel is negligible; the products of combustion are harmless, and do not smell any worse than the domestic fire.

The water-tube boiler is nothing more than a "pot" boiler enclosed in a casing, made the same shape as the shell of an ordinary boiler; and it is fired from a bottle or can. It can be made very quickly, has less joints, and is lighter than the loco.-type. It will make plenty of steam, when fired by either oil or spirit, for all normal conditions of working; but an exceptionally heavy blast, caused by a grade or big load. will draw cold air through the casing, and check steam generation. It usually makes more steam than an efficient engine needs on light load or slow speed and blows off a great deal, unless the wicks or burner are adjusted to suit; it also wastes more heat than it uses, through the metal of the outer casing, unless this is made double or heavily lagged, and renders the whole engine rather precarious to handle. It is either noisy or noisome in operation; if fired by oil, there is the roar or hiss of the burner; and if fired by methylated spirit, there is the unpleasant odour. However, you can fill the boiler nearly up to the safety-valves, adjust your wicks or burner, hook on a load of coaches, and start the locomotive on its journey; it will then "keep on keeping on" until the boiler runs dry or the fuel gives out, giving a much longer run without attention than the loco.-type. So what you lose on the swings you gain on the roundabouts! Well, here goes to construction.

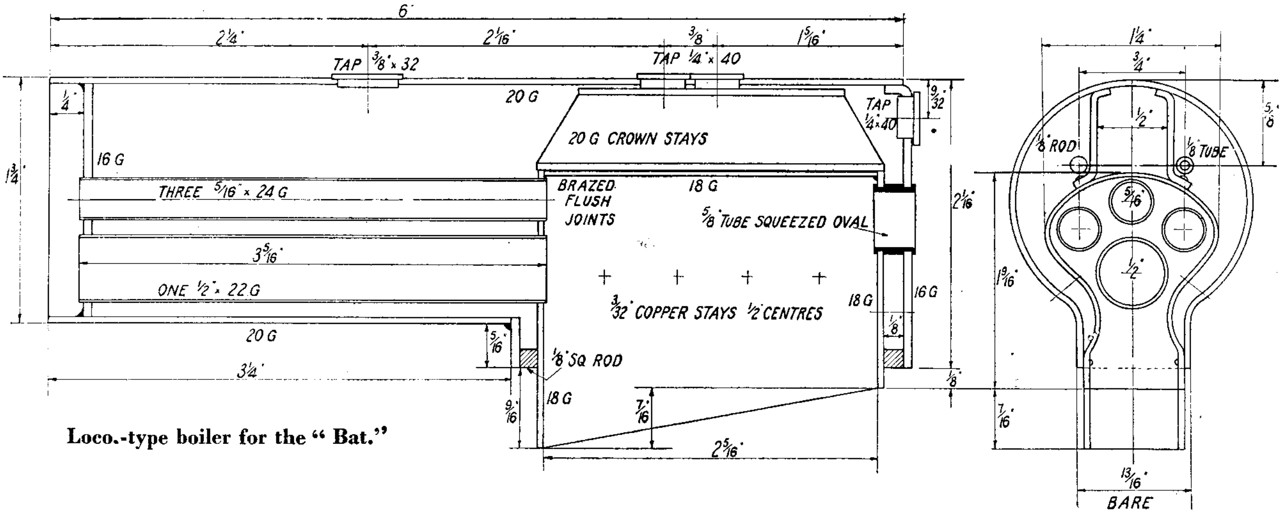
## Loco.-Type Boiler

This is much simpler to make than the $2\frac{1}{2}''$ gauge size, inasmuch as no plate flanging is needed, except on the backhead. The sides of the foundation ring are dispensed with, the firebox sheets being bent outwards at the bottom, and brazed direct to the wrapper, giving a firebox of sufficient depth, and a grate area wider than with the usual form of construction. Comparatively large tubes are used, both to simplify the construction and minimise risk of choking, as cinders, etc., will not oblige by "scaling" themselves down to the engine. The superheater flue is at the bottom, not because it does any better in that position, but because it made possible a neat and symmetrical little firebox and tube assembly.

The barrel and wrapper of the boiler are made in one piece, from a $6''$ length of $1\frac{3}{4}''$ by 20 gauge (or 22 gauge) seamless copper tube. Square off the ends in the lathe; saw longitudinally down one end for a distance of $2\frac{3}{4}''$; then make a cross cut, just over an inch in length, at the end of the longitudinal slit. Soften the copper by heating to redness and plunging into cold water; then open out the metal each side of the saw-cut to the shape shown in cross-section. Trim off the saw-marks with a file.

Cut a piece of 16 gauge sheet copper to fill up the opening at the front end, under the barrel, between the sides of the wrapper sheet. Clean the places where the metals touch, place plate in position, and tie it with a piece of thin iron wire. This throatplate should jam in the sawcut between the barrel and the bent-out sides of the wrapper, and care should be taken to ensure that the distance between the latter is correct, otherwise the boiler will not sit down properly on the frames.

The joints can then be brazed; and for new readers' benefit, here is a very brief summary of the operation. A one-pint paraffin blowlamp, or a small gas blowpipe, is all that is necessary for heating. An old tray with a few handfuls of small coke or breeze is O.K. for a forge. Easy-running brazing strip, obtainable from any of our advertisers who sell castings, etc., is used for some outside joints, and ends of firebox; flux for this is either "Boron" compo., or any other good brand, mixed to a paste with water. For tubes, foundation ring, backhead and bushes, No. 1 gradé silver-solder is used, with same flux; but if you can get it, the kind known as "Easyflo," with "Tenacity No. 3" flux, gives excellent results even in the hands of the rawest recruit.




Loco.-type boiler for the "Bat."

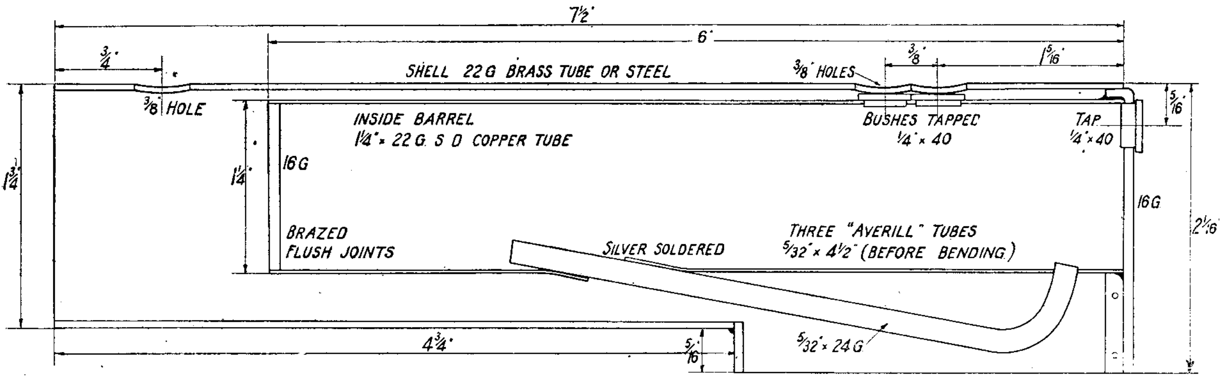
Brazing consists of packing some of the coke or breeze around the job laid in the tray; paint some of the flux paste all over the joints to be brazed; heat the metal slowly, and when it reaches bright red apply the stick of brazing material, which should be dipped in flux, to the joint. If the heat is sufficient, it will melt and flow in, just like soft solder. Start at one end, and move the flame slowly along the joint, applying more strip as you go. The process is just as easy as soft soldering. When through, let it cool to black, and dump in a pickle made from one part of commercial sulphuric acid to about 20 of water. After a while, the time depending on size of job, fish it out with tongs, wash in running water, and clean up. Silver-soldering is carried out in exactly the same way, except that a dull red heat is all that is necessary.

To braze in the throatplate, stand the boiler shell end-up in the coke, barrel pointing skyward, and proceed as above.

### Water-Tube Boiler Outer Shell

This is made in exactly the same way, using a piece of brass tube $7\frac{1}{2}''$ long, smokebox and barrel being all in one piece. Use silver-solder to fix the throatplate; the heat necessary to make brazing strip flow will melt the brass. Alternatively, a steel outer shell may be used; and really it is the best, because steel does not radiate the heat so much as brass. Do not use a copper outer shell for a water tube boiler, or a large amount of heat will be wasted. The easiest way to make a steel shell is to cut a piece of soft mild steel sheet, about 22 gauge, $5\frac{3}{4}''$ wide and $7\frac{1}{2}''$ long. At $2\frac{3}{4}''$ from one end, on each long side, make a snip about $\frac{1}{2}''$ long. Roll the steel around a piece of wood or metal of suitable diameter, allowing the metal which is the longer between snips and end to overlap about 3/16". Rivet it with a few 1/16" brass rivets; then open out the metal which is shorter between the snips and the end, to form the sides of the firebox wrapper. Fit a throatplate as mentioned above, of 18 gauge steel, and braze it; but instead of using strip use ordinary soft brass wire, and quench out in water only. Acid pickle is not used for iron and steel.

The firebox is bent up from a piece of 18 or 19 gauge sheet copper, a full 5" long and 2 5/16" wide. Be careful to get it to right shape. Clean the ends; stand it end-up on a clean piece of 18 gauge copper, about $2\frac{1}{8}''$ by $1\frac{3}{8}''$, laid in the coke, then braze all around it, letting the brazing strip run freely so that it penetrates to the inside and forms a fillet. Pickle, clean, and wash off;




Water-tube boiler for the "Bat"

then cut the end piece to the contour of the firebox and file it flush, all around. Trim off the bottom edges to the requisite slope, viz., 7/16″ front to back, then stand the open end on another piece of copper about $1\frac{5}{8}''$ by $1\frac{3}{8}''$, and repeat operation. This butt fitting of the end plates is perfectly safe and quite satisfactory for this tiny boiler. It has been used—though not by me—in building boilers for 5″ gauge engines.

Drill the tube holes, as shown, in the longer end of the firebox; also cut a disc of 16 gauge copper to fit in the end of the barrel and form the smokebox tubeplate, and drill similar holes in it. The firehole ring is a $\frac{3}{8}''$ length of $\frac{5}{8}''$ by 16 gauge tube, with a step 1/32″ by $\frac{1}{8}''$ turned at each end. Anneal it, and squeeze it oval. Lay it on the shorter end of firebox, scribe a line all around, cut out the piece by drilling and filing, push the end of the ring through, and burr over the flange on the inside, so that the plate is gripped between the burred-over edge and the shoulder.

**Girder Stays**

The girder crown-stays are made of 20 gauge copper, and riveted to the crown of the firebox, as shown. Only three or four 1/16″ rivets in each are needed, as the flanges are silver-soldered to the crown sheet, making them practically solid with it. Note: these girders must extend right to the extreme ends of the tube and door plates; and the distance from crown of box at point of attachment to the top of upper flange is $\frac{5}{8}''$.

The tubes are now cut to length and inserted in the tubeplate. Have the ends nice and clean, and slip on the smokebox tubeplate at the outer end, to keep them in line whilst being silver-soldered, which job can now be done. Paint flux over tube ends where they enter tubeplate; also along crownstay flanges, and around firehole ring. Up-end the assembly in the brazing pan, tubes pointing to the clouds, and heat up partly outside and partly in, taking care not to direct the flame on the tubes until the tubeplate is red. Then apply the silver-solder, and give a blow-up from the inside of box to ensure it running through. Stand the firebox right way up, to run the silver-solder along the crownstay flanges, then stand it on the smokebox tubeplate to do the firehole ring. Do not let it get too bright a red, or the brazing of the end plates might start to give. The difference in melting point between the strip and the silver-solder gives quite sufficient margin of safety with ordinary care. Pickle and wash off, and remove the smokebox tubeplate.

**Fitting Firebox and Tubes to Shell**

Cut a piece of copper rod, $\frac{1}{8}''$ square, just long enough to jam tightly against throatplate between sides of wrapper. Slide the firebox and tube assembly into the shell, so that the firebox tubeplate comes up against the rod. Centre it, and hold in position with a clamp. Put a clamp also on one of the crownstay flanges, to hold it against the top of wrapper. See that the crownstay flanges bear against the wrapper all the way along, then put one rivet in each, just to hold them. Put a couple of rivets through throatplate, $\frac{1}{8}''$ rod, and firebox tubeplate. Bits of copper wire will do, burred over each side; it is only to hold the bits together whilst operating with the blowlamp or pipe. Then insert the smokebox tubeplate to depth shown in sketch, guiding the tubes into the holes with a wooden skewer. Plug the ends of the tubes with little wads of asbestos string, and we are all ready for brazing this lot.

Paint the joints with flux; then up-end the boiler in the pan, and carefully heat up the whole end of the barrel. Apply a little silver-solder to the tube ends; then feed in some of the strip to the circumferential joint. If the flame is applied *outside* the barrel immediately the strip begins to flow, you will find it easy to work right around, and feed in a lovely smooth fillet. Now lay the boiler on its back, with the firebox wrapper overhanging the forge or pan. Lay a strip of silver-solder alongside each crownstay flange, and blow in at the end until the stuff starts to melt. Then play the flame outside from the underneath, which will " sweat " the silver-solder clean through the flanges. Do not do anything to the little bit of foundation ring by the throatplate, this receives attention when we go around the bottom of firebox. I think that will amuse the " locotypers " for a while, but if they " catch up," make a backhead as described below for water-tube boiler, as this is the same on either type.

**Inner Barrel for Water-Tube Boiler**

First make the backhead. This is knocked up from 16 gauge sheet copper, over a 3/16″ iron or steel forming plate cut to the shape of the cross-section, less 1/16″ all around except at bottom. For tyros—soften the copper, clamp it in vice alongside forming plate, and beat down the edge of the copper on to the edge of the iron plate. Remove, and file off any raggedness. If the copper is cut to the shape of forming plate, plus 3/16″ all around except bottom there will be little to trim.

The barrel is a 6″ length of $1\frac{1}{4}''$ by 22 gauge seamless copper tube. Square off the ends in the lathe, clean them, and drive a disc of 16 gauge copper into one end. Drill the two bush holes 5/16″; lay the backhead in the brazing pan, stand the open end of the tube on it, close to the flange, with the bush holes at top, and paint around the joint with flux. Also put some flux around the disc in the other end. Blow up the backhead to bright red, also the tube where it rests on the backhead, and apply some brazing strip, running it in a nice fillet all around. Then play the flame on the end disc, applying the strip to that, as soon as it reaches bright red. When the metal has run in, all the way around, let cool to black, pickle and wash off. Be careful of getting splashed when the acid pickle runs into the hot barrel through the bush holes, as it is usually blown out again, and is not particular as to where it goes!

# Railway Practice

By Chas. S. Lake, M.I.Mech.E., M.I.Loco.E.

## Railway Workshop Reorganisation

THE writer has been asked to include in the notes he submits to the Editor an occasional reference to railway workshops, preferably where schemes of reorganisation have been put into practice during recent years. The two illustrations reproduced by the courtesy of Sir Nigel Gresley, Chief Mechanical Engineer of the L.N.E. Railway, show (1) the interior of the locomotive erecting shop, and (2) the carriage lifting shop at the Company's works at Stratford, London.

Under the scheme of re-organisation introduced a few years back, the locomotive erecting shop, originally built by the Great Eastern Railway in 1917, was re-planned in 1933 for the maintenance of the largest of the locomotives which could be conveniently dealt with in the original shop for erecting and repairs. The output is, or was, kept down to approximately three engines a week, by doing which it is possible to restrict the actual repair work to one of the three bays. Wheel repairing is done in the centre bay, whilst the third bay is utilised for repairs to locomotive boilers and tenders. The carriage lifting shop, shown in the second of the two illustrations, operates in conjunction with the carriage body and other shops adjacent to it. In practice, about 50 per cent. of the coaches dealt with at the works come in for lifting only, and are, after examination, delivered to a point outside the building where they are returned to traffic. The vehicles requiring body or other repairs are passed from the lifting shop by the traverser and placed on the two outside tracks of the main repair shop. The coaches are brought into the lifting shop by means of an electric capstan and placed at given points on the two lifting tracks at the entrance to the building. The vehicle, when lifted, is placed upon "shop bogies," and the bogies of the carriage itself are thoroughly cleaned in "bosh" tanks; the brake gear is overhauled and tested, steam heating apparatus and other parts examined and where necessary adjusted and repaired. The coach travels along over electrically lighted pits so that the under gear can be examined without the use of torches. At the other end of the shop, it is re-mounted and sent out of the shop ready for service again.

**One of the bays in the locomotive erecting shop at Stratford Works, L.N.E.R.**

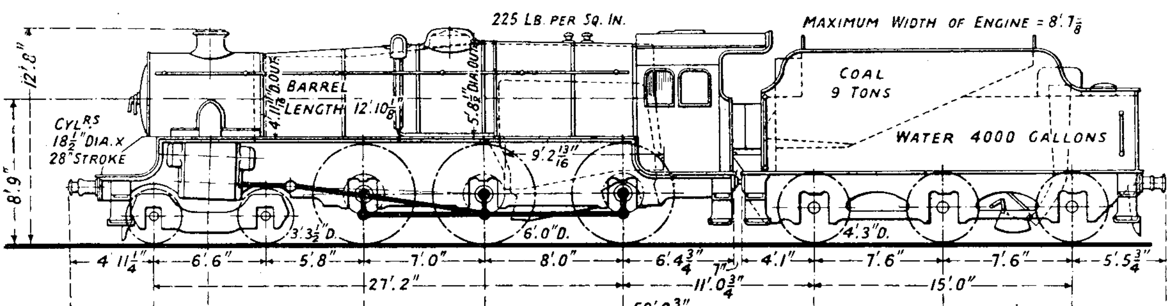
**Interior of carriage lifting shop at Stratford Works, L.N.E.R.**

## Mixed Traffic Locomotives

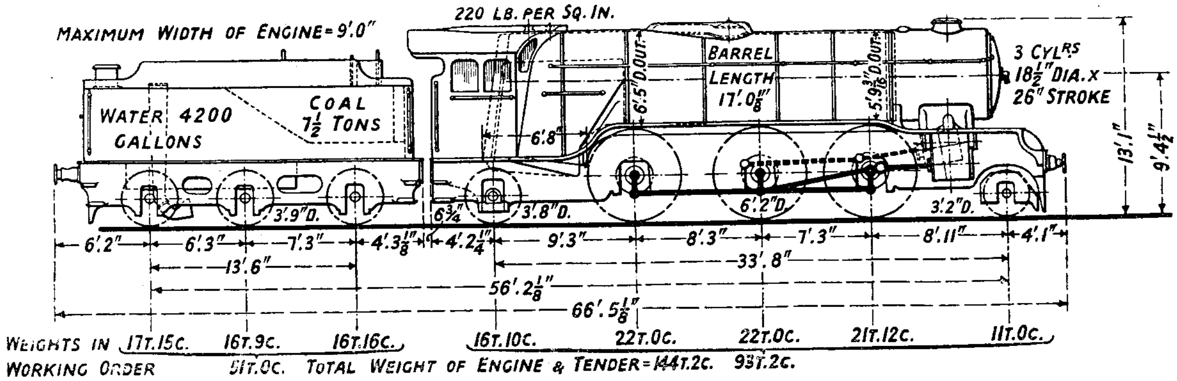
A Doncaster reader asks for information respecting the "proper technical" description of a mixed-traffic locomotive, especially one that belongs to what is sometimes referred to as the "general utility" class. He instances two types which he thinks come well within the meaning of the term as understood by him, viz., the class "5P5F" of the L.M.S. and the "V2" or "Green Arrow" design of the L.N.E.R. The writer does not, however, agree that these are comparable types for the reason that the L.M.S. design with the 4-6-0 wheel arrangement and moderate axle loading is a more compact design, and built to dimensions and weights that permit of its use, not only on a variety of train classifications and schedules, but on virtually all sections of the main and certain branch lines.

The "Green Arrow" class of the L.N.E.R. are very fine engines and can be relied upon to give the most admirable results on fast and stopping passenger trains of considerable weight, and also on heavy freight and braked goods trains, but the fact cannot be ignored that the coupled axles carry 22 tons, for the driving and trailing, and 21 tons 12 cwts. for the leading pair of wheels. The total weight of the engine without tender is 93 tons 2 cwts., and these figures must necessarily make it impracticable for the engines to work over any but the heaviest track standards.

The L.M.S. engine on the other hand, has coupled axle loadings averaging only 17 tons 11




**L.M.S. "5P5F" mixed traffic locomotive.**




**L.N.E.R. mixed traffic engine, "Green Arrow" class**

cwts. per axle, and the total weight of 70 tons 12 cwts., the result being seen in the fact that the locomotives which number some 500 as against the 100 of the L.N.E.R. "V2" class are usable, as before said, on practically every section of the L.M.S. Railway. If the term mixed traffic be used, then both of the types referred to adequately meet requirements, but the broader one of "general utility" rules out the "V2," as will clearly be recognised.

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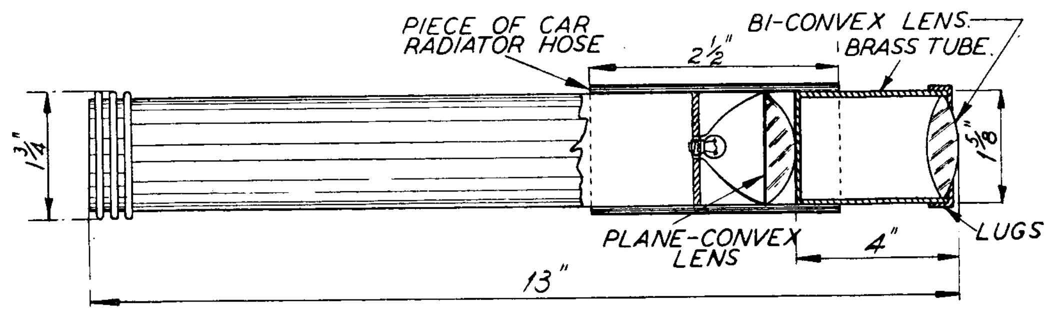
# A "Torch" Pointer for the Lecturer

**By W. S. Sholl**

HERE is a useful pointer for the lantern lecturer which does away with the rather inconvenient "fishing rod" used to point out the details so often found in the technical picture thrown on the screen. The part-section is practically self-explanatory, but the following details will clear up any points in doubt. The torch is the large 3-cell plano-convex lens. The front lens, objective, is a small magnifier, bi-convex, held by three shaped lugs soldered to the brass tube. The arrow should be quite small, as the magnification is considerable: 1/16" for the shaft and ⅛" wide for the base of the head, with ½" overall length is satisfactory.




PART-SECTION TORCH POINTER

4½-volt type, serving a 3½-volt bulb. The shaded sleeve over the bulb and reflector is a piece of car radiator hose which can be detached to leave the torch in its originally intended state. The "condenser," i.e., the lens just forward of the bulb, is removed and a disc of black paper, having an "arrow" cut out. just off the centre in this case, is pasted to the plane side of the

In use the torch is assembled, the battery switched on and the arrow focussed at about 10 ft. from the screen.

As everything, bar the brass tube, was in the writer's possession, the total for bought out material was 5d. With everything to buy, the total cost should not greatly exceed 5s., as against 27s. 6d. for the purchased article.

# *Internal Back-Gear for a Small Lathe

**A useful accessory that occupied many pleasant hours in its construction**

**By William Barlas**

### Carrier for Locking-Pin

Turn from mild steel bar, $1\frac{1}{4}'' \times \frac{1}{2}''$. This can be finished off complete. See Fig. 8.

### Locking-Pin

This does not need any special description. If made from cast steel it will not be necessary to harden. See Fig. 9.

### Spring for Locking-Pin

Bend up from 20 gauge piano wire, Fig. 10. The eye of the spring is clipped under the head of one of the screws holding down the carrier, and

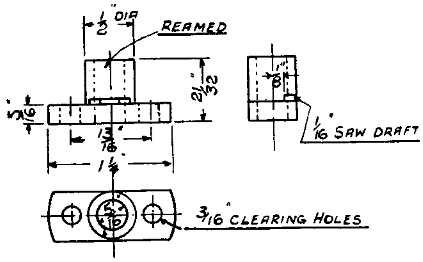



**Fig. 8. Carrier for locking-pin, 2 off, M.S. machined all over.**

the spring passes through the saw draft in the carrier, the turned-up end bearing on the inner flange of the cone. The function of the spring is to provide a quick method of locking the cone to the fixed plate. When the locking-pin is pushed home, the spring snaps into the groove cut in the pin and holds it securely.

The fixing screw, Fig. 11, the nut for the centre gear (cone end), Fig. 12, and the nut for the centre gear (fixing plate end), Fig. 13, do not need any description.

This completes most of the construction, but there are a few components which can only be finished now.

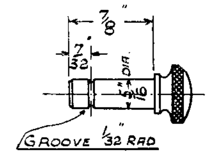



**Fig. 9. Locking-pin, 1 off, cast steel.**

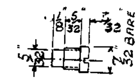


**Fig. 11. Screw for fixing centre gear wheel to mandrel. Silver steel, hardened.**

Place the centre gear in position in the cone, put the planet pinions and wheels in position and screw in the pins. Put a thin washer under the heads of the pins so that when the pins are screwed down the wheels and pinions are jammed solid. Now place the fixed pinion only in position on the centre gear and in mesh with the planet wheels.

Hold the fixed pinion stationary and turn the centre gear slightly so that the backlash is taken up one way on all wheels. When this is obtained, screw down the pins tight so that the planet wheels and pinions are clamped together, making sure

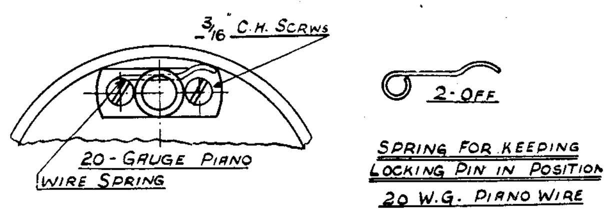
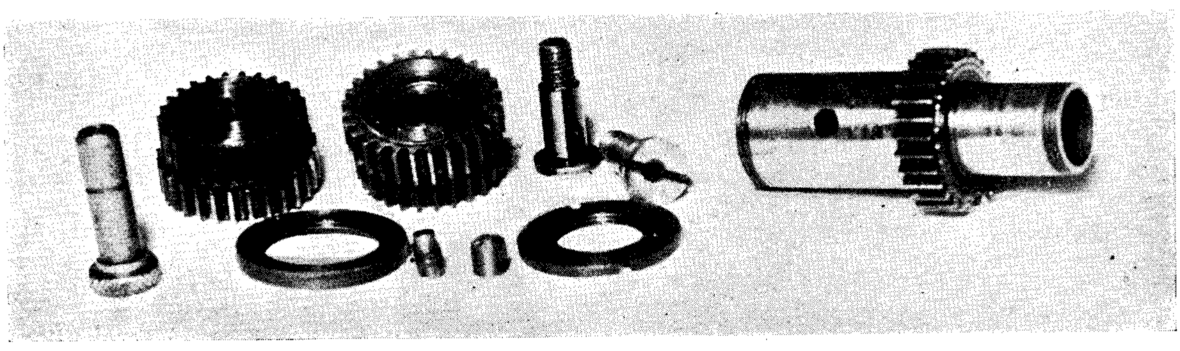



**Fig. 10. Showing how locking-pin carrier and spring are fixed to cone.**

*Continued from page 264, "M.E.," March 14, 1940.



**Various small components of the internal back-gear.**

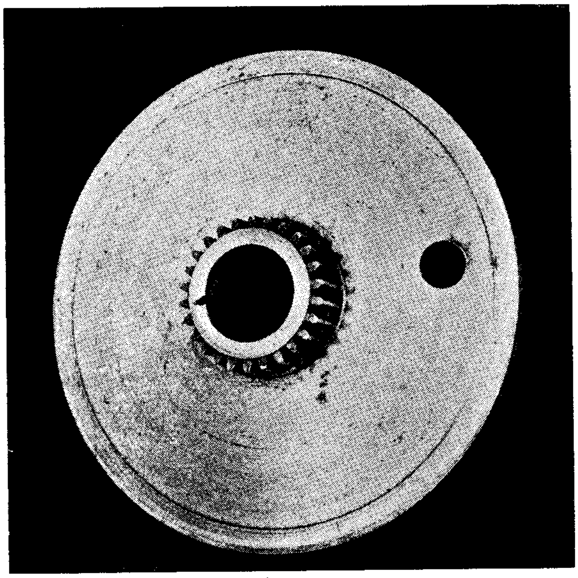
that no movement takes place during the tightening down.

The assembly is now placed on the drilling machine and the rivet holes in the pinions drilled, using the three drilled holes in the wheels as a jig. The wheels can now be removed, the holes countersunk, and the gears riveted together with pieces of silver-steel, which should be a good driving fit in the holes.

When riveting, a piece of steel, a tight fit in the bore, should be driven in, and this will ensure that the gears remain concentric.

### Hardening

In the case of gears which are to be hardened, the hole for the pin will have a grinding allowance, and it is not possible to use the pin, as this will not be ground to size until after the gears are



**Fixed plate and pinion.**

hardened and ground. In this case, turn up two pins in mild steel to fit the holes in the unhardened blanks. Drill for rivet holes, countersink, then harden. The gears can now be riveted together and the bore ground out, after which the hardened pins will be ground to fit.

We can now proceed to fit the locking-pin carriers to the cone. This can be done accurately as follows:—

Take the fixed plate and scribe a line across the face and edges. This line should be exactly across the diameter. Now take the cone, and likewise scribe a line across the inside face at right-angles to the two tapped holes for the planet gear pins. Carry this line out to the outside diameter.

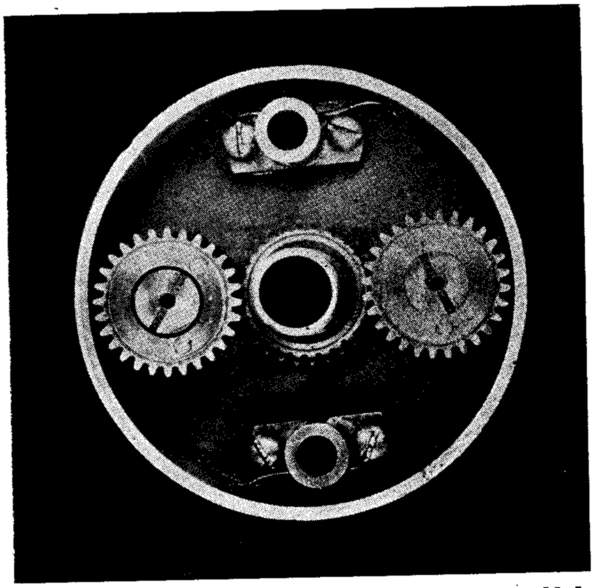
Place the carriers inside the cone and press out against the inside diameter. Measure the centre distance of the holes which take the locking-pin. If we presume this to be the size given on the drawing, viz., $2\frac{1}{2}''$, then scribe a line on the fixed plate at $1\frac{1}{4}''$ radius cutting the diametrically scribed line. At the point of intersection, drill a 5/16″ hole.

Assemble the centre gear wheel in the cone and place on it the fixed plate. Turn the latter so that the scribed line agrees with the line scribed on the cone. Now pass a bolt through the centre bore, place a washer on top and clamp cone and fixed plate solidly together.

The assembly is now placed on the drilling machine and a 5/16″ drill passed through the drilled hole in the fixed plate and run into the face of the cone about $\frac{1}{8}''$.

The bolt is now loosened and the fixed plate turned round 180° until the scribed line agrees with the line on the cone on the opposite side. The drill is again put through the hole in the fixed plate and run into the face of cone about $\frac{1}{8}''$. If we now remove fixed plate, we should have two shallow holes which coincide with the hole in the fixed plate and are also at right-angles to the planet gears. These holes are used to locate the carriers in position thus:—

Take a piece of 5/16″ diameter mild steel, about 1″ long, and push this through one of the carriers and enter into the shallow hole drilled in the face of the cone. Clamp the carrier down in this position, and spot through the 3/16″ clearance holes with a drill. Repeat with the other carrier on the opposite side; remove carriers and drill into the spotted holes with a 3/16″ tapping size drill; tap holes. By this method, the hole in the carrier is bound to come in line or coincide with the hole in the fixed plate.



**Centre gear, planet gears, carriers and springs assembled in cone.**

### Assembly

The entire arrangement can now be assembled.

Place the centre gear in the cone and screw on the nut. This should be a tight fit, and should

be screwed on until there is no end-play, but the cone should turn freely. Take the two planet gears and place in position on each side of the centre gear. Screw in pins. These should also be a tight screwing fit. Screw down the carriers, placing a spring under the head of one of the holding-down screws, as shown in the small

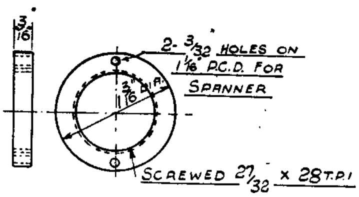



**Fig. 12. Nut for centre gear wheel (cone end) M.S. 1 off.**

arrangement. The fixed plate should have the fixed pinion screwed in tight, and grub-screw fitted, the whole being placed on the centre gear and the nut screwed on.

Try pushing the locking-pin into each carrier and see if it goes in nicely, and that the spring snaps into the groove.

If correct, the entire assembly can be placed in position on the mandrel, and the fixing-pin hole drilled in the mandrel, spotting through the hole in the cone and centre gear with a drill, after which the fixing-pin can be dropped down and screwed up tight with a narrow screwdriver. When this is done, try revolving the cone, and make sure that the head of the fixing-screw runs clear in the groove in the bore. A plain grub-screw, screwed $\frac{1}{4}''$ × 40, should be screwed into the tapped hole in the cone.

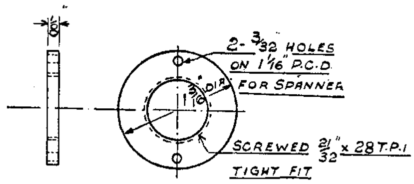



**Fig. 13. Nut for centre gear wheel (fixing plate end) M.S. 1 off.**

## Locking the Fixed Plate

This completes the construction, but it will be necessary to provide some means of locking the fixed plate when the back-gear is required.

The writer arranged his as shown in the sketches, but a great deal depends on the shape and style of the headstock, and it might prove necessary to alter this arrangement. The one shown is quick and foolproof in use and works just like the usual spring index pointer as used for a division plate, the only difference being that the spring is stronger and the pin or pointer is 5/16″ diameter to fit the hole in the fixed plate.

In use, when single gear is required, the fixed plate is locked to the cone by means of the locking-pin, but when back gear is necessary the locking-pin is withdrawn and the fixed plate held stationary by means of the index-pin.

## Conclusion

To conclude, it might be advisable to give a simple indication how the gear works, and how to arrive at the ratio.

Let us imagine that we are looking on the gear at the fixed plate end and that the cone is held

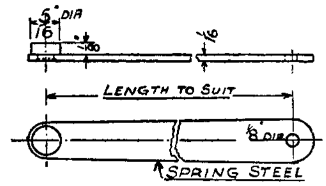



**Fig. 14. Anchor for fixed plate.**

stationary. If we turn the fixed plate round one revolution in a clockwise direction we find that the fixed pinion also makes one revolution in a clockwise direction, since it is part and parcel of the fixed plate. This pinion is in mesh with the planet wheel, and, as these have 26 and 28 teeth respectively, it will be evident that the planet wheel will make 26/28 of a revolution, anti-clockwise. This means that the planet pinion, which is riveted to the wheel, must also make 26/28 of a revolution in an anticlockwise direction; but this pinion is in mesh with the centre gear, and, as the pinion has 26 teeth and the centre gear 28 teeth, and as the pinion has made 26/28 of a revolution, then the centre gear must make 26/28 × 26/28, i.e., 676/784, of a revolution in a clockwise direction.

Our next step is to imagine that the fixed plate is held stationary and the cone turned one revolu-

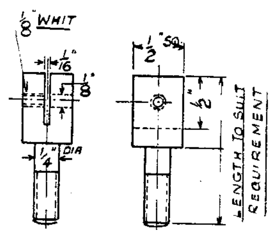



**Fig. 15. Support for anchor, mild steel.**

tion in an anticlockwise direction, which is the direction in which it would run when in use.

The cone, as mentioned, is turned through one revolution, and as the planet wheels are attached to the cone, these run with it, and, accordingly, the planet wheel moves round the fixed pinion, which is held stationary. In so doing, it revolves exactly the same as if the fixed pinion had been moved one revolution in the opposite direction, and this, as shown previously, caused the centre gear to revolve 676/784 of a revolution clockwise, but as the cone has carried the whole lot round one revolution anticlockwise, and as the centre gear has turned back 676/784 of a revolution, we can see that the ultimate result is that the centre gear has made 1 − 676/784 anticlockwise = 108/784 = 7 7/27 to 1.

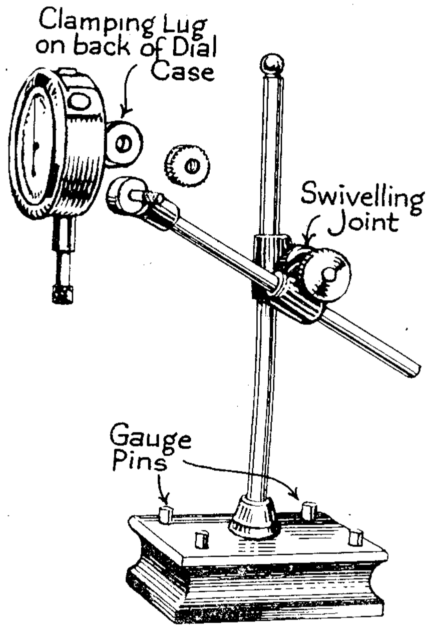
# *Gauges and Gauging

**A series of great value to engineers of all classes, particularly those who are engaged upon national service**

**By R. Barnard Way**

WE have now examined a good many different appliances designed to make small measurements and others to record small differences in measurement from a standard. It is time we went into the subject of the application of these aids to good work.

The use of the micrometer we need not enlarge upon, though its occasional specialised use will occur from time to time. As our last article dealt with the dial gauge, it might be opportune to show some of the things that can be done with that. To get full value from such a gauge, one or two simple pieces of apparatus are desirable—necessary, in fact.



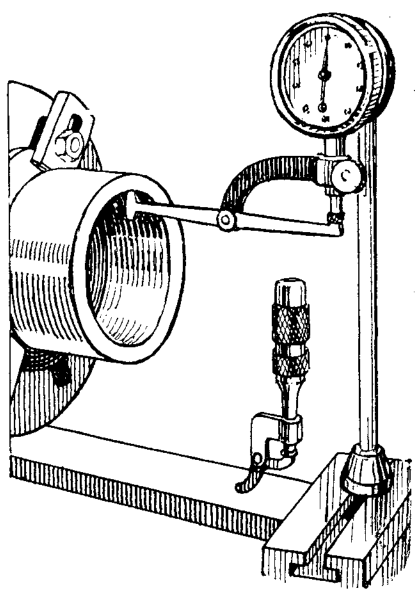

**A dial test indicator.**

Chief amongst these is the test indicator, a steel post set vertically in a heavy base, the underside of which is finished to a fine surface so that it can be used upon a surface plate. In the example illustrated here, gauge pins are provided at the four corners to permit of employing it against the edge of a T-slot or edge of the surface plate.

A sliding clamp on the post carries a swivelling arm, at one end of which is a lug to engage with the lug on the back of the dial gauge. In some cases the vertical post can be turned in the base, a clamping nut is provided to lock its position. This would always be the case when the base has a T-slot cut in it, both top and bottom.

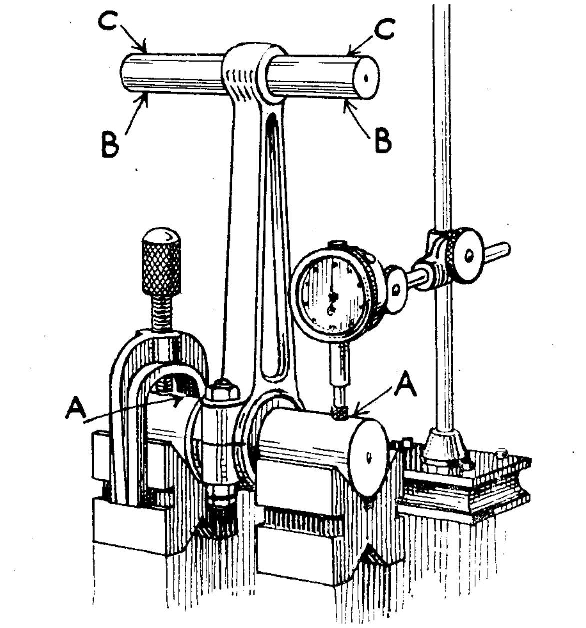
Other useful little gadgets consist of extension levers of light construction to enable odd corners to be reached. One of these would be about 6 inches long, its pivot exactly central, supported by an arm clamped to the barrel enclosing the plunger of the dial gauge. The other one is a bell-crank, useful for turning the plunger foot in effect round at right-angles, thus making one gauge serve two purposes. We illustrate these two, from the products of Messrs. Brown and Sharpe, but, to make our illustrations serve two purposes also, we show the gauge doing a job of work. In the first place, with the extended arm, a hollow casting is being adjusted in the face-plate of a lathe ; by turning the lathe spindle a quick indication is obtained as to the truth of the setting. This is a job for which dial indicators are especially suitable, justifying their cost many times over in the shop where a considerable amount of repair work has to be handled. Setting up a cylinder in the lathe is a case in point, for unless it is TRUE, the job will be ruined from the first cut almost.

We have mentioned the subject before, and may have cause to mention it again, but it can never be too strongly emphasised that absolute cleanliness must be maintained wherever appliances such as this are in use. A speck of iron having a



**Extension levers for use with the dial gauge.**

* *Continued from page*, 261, "*M.E.*," *March* 14, 1940.




**Testing the truth of a connecting-rod by dial gauge.**

thickness of only 0.001″ is not very easily detected, but it can set the readings of your dial gauge all out. It is usual to keep the surface plate clean, but not always so with the bed of your lathe or other machine tool. If you are to stand the test indicator on the slide bed of the lathe, it is necessary to give it an absolutely clean surface to bear upon, and that does not mean just a rub over with a handful of oily waste. We cannot allow even a film of oil between the surfaces if any real precision in measurement is to be made, for oil films, especially the dirt-laden heavy oil films met with in machine shops have a very definite thickness indeed, sometimes measurable with an ordinary steel rule. This is not to suggest that we rate the intelligence of the mechanic as low as all that, but, we have seen—well, what we have seen.

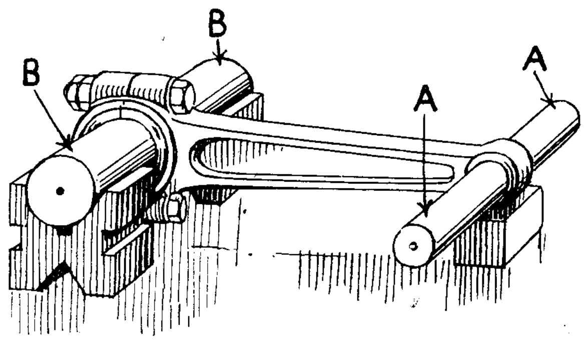
## Testing for Alignment

In engine-building, where single units or small groups of parts only have to be made and assembled, testing for alignments can be carried out most effectively and accurately by using dial gauges. There is no difficulty in thinking of portions of working parts that must be strictly parallel or at right-angles; as an example we might take the big and little ends of a connecting-rod, the centre lines of which must be absolutely parallel, and of course, at right-angles to the centre of the rod. Again, with a piston, the centre line of the hole for the gudgeon-pin must be at right-angles to the centre line of the cylinder bore, which means parallel with the planes of the head and skirt of the piston.

Two sketches show how this can be done, and though they do not suggest mass-production methods of testing, it is obvious that the method is applicable to small quantity production. Mandrels will have to be made, one for the big-end, and one for the little-end, this latter will serve also for the gudgeon-pin hole test. These mandrels should be ground to a diameter 0.005″ less than the respective bores they are to fit, and their lengths should be about five times those of the bearings. The connecting-rod is set in an upright position with the mandrel resting in V-blocks on a surface plate. The dial gauge can now be clamped to the pillar of a test indicator, and its measuring foot brought into nice contact with the top of the extreme end of the mandrel, using the fine adjustment. Set the pointer of the dial at zero, and then shift the set-up over to the other end of the mandrel, when the reading should be the same. This process process must be repeated with the little-end, so that a specially long pillar to the test indicator is necessary, or else some similar device can be contrived for the purpose quite easily.

Supposing some error shows in between any two readings thus taken, what do we make of it? The idea of the long mandrels is clearly to exaggerate the error and make it more plainly measurable. If the difference between the readings at the bottom only amounts to 0.001″, then the assumption might be that the mandrel was not seated properly in the V-blocks, but on checking, if this difference persists, then it must be taken that the centre line is out of truth by half of this amount—0.0005″. Now, if the test of the little-end produces a similar result, then there is no error between the two centre lines.

On the other hand, if the error is greater than this, say, 0.002″ between readings, then there is



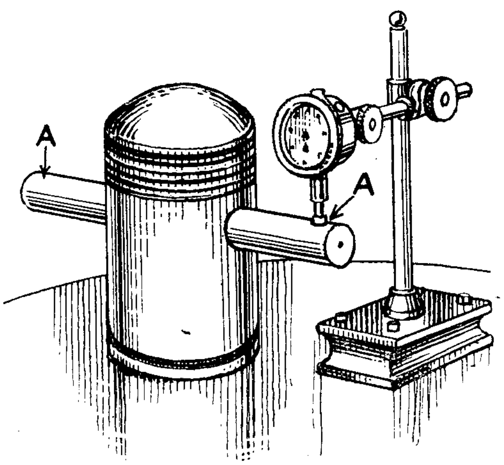

**Test arrangement for connecting-rod.**

an error in the alignment of 0.001″. Dealing with this is, of course, not our province, so we will pass it back to the shops, but not until we have applied another test of the same sort, to check up for possible twisting.

This is effected by turning the connecting-rod in the V-blocks until its centre line is approximately parallel to the top of the surface table, resting the little-end upon a small block. If the same test be now carried out on the little-end mandrel, we shall get a precise indication of the truth. Errors, if any, are calculated in the same fashion as before, and dealt with in whatever way the size of the piece may justify.

Testing the gudgeon-pin hole in the piston is done similarly to the foregoing, except, of course, that the piston stands directly upon the surface table. Exact parallelism between skirt-head can also be checked, provided that the head has not got a domed top to it, by carrying out this test with the piston head up, and then skirt up. If all is well, the readings should correspond.

The dial gauge can be absolutely invaluable to get information as to the truth of the bore of an engine cylinder. All that is necessary is a three-footed table arrangement, to slide into the cylinder, having some form of clamp to secure the dial gauge in a vertical position. Such an arrangement is shown in the sketch herewith, from which it can be seen that the three feet are not in the same plane, thus permiting the table to stand in an upright position inside the bore.

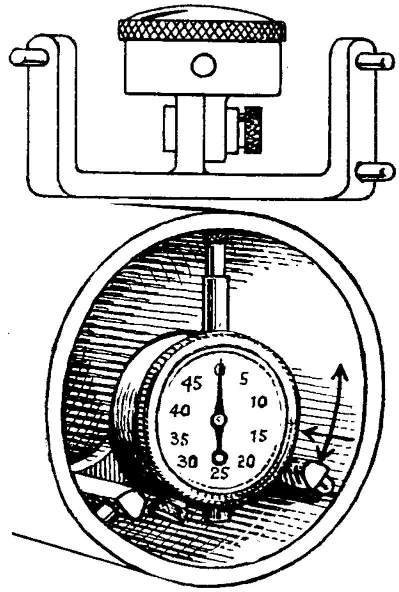



**Dial gauge and test indicator.**

Now, if the table is put just inside the cylinder, and the dial gauge clamped in position so that its measuring foot is in contact with the top surface of it, we have a three-point gauge, which should keep contact with the surface however it is turned or slid up and down in the bore. If pressure is put on the measuring foot to the extent of one revolution of the needle, and the scale re-set to zero, then readings of error plus or minus will be clearly registered.

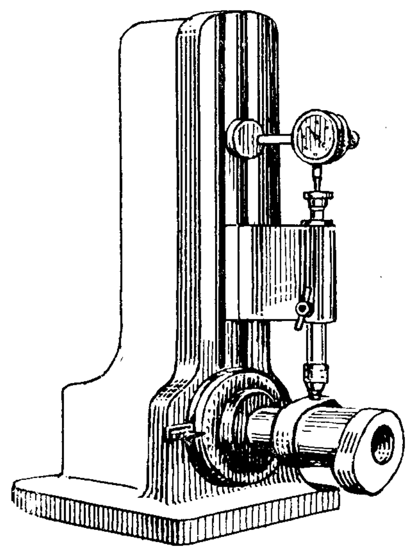
Such a method of testing is most useful where a big cylinder is suspected to have worn, for it gives positive indication of the clearest sort, as well as a precise record of the extent of the wear and the part of the cylinder that is at fault.

There is a possible difficulty with the three-footed type of gauge table inside the cylinder bore, in that it is quite possible for it to take up a position not truly parallel to the centre line. Where good readings are required this would be most important, and an alternative arrangement might be preferred. A rectangular slab, its sides finished exactly parallel and slightly rounded—but very accurately so—has a bracket in the centre to take the lug on the back of the dial gauge. This slab will slide into the cylinder, and will maintain parallelism inside the bore, though to secure this to the greatest possible extent it must be relatively long. Because of this necessity,




**A device for testing the true circularity of a cylinder bore. Above, view showing tripod frame; Below, the device in service.**

unless two or three brackets are provided for the dial gauge it will not generally be possible to carry the readings right up to the top of the bore with



**Checking the lift, and points of commencement and ending of lift of a pair of cams.**

cylinders having a closed head. Where a regular job of this sort of gauging has to be undertaken, obviously a slab can be provided specially for the work.

To check the truth of shafts is a relatively simple matter with a dial gauge, for it is quite easy to fix the gauge to a bracket so that its foot bears on the shaft to be tested. Rotation of the shaft will show up any ovality in its shape immediately. A shaft that has been ground to the shape described by Mr. Arthur Carter in a recent number of THE MODEL ENGINEER would give a continuous series of indications of a bewildering sort ! Shafts under test in this way can be carried either in their own bearings or else in V-blocks, but if in the latter, they should always be set up on the surface table. It is not possible to over-emphasise the necessity for every precaution of this sort when measurements of the order of thousandths are being made.

**Testing Cams**

In a somewhat similar manner the truth of profile of cams formed upon a shaft can be checked. With a camshaft that has seen much service and is suspected of wear, having developed a hollow spot as they often do, the profile can soon be gone over and any hollow will be faithfully recorded at once. New camshafts are usually tested by an arrangement similar to that shown in the sketch. Not only its smoothness of profile, but its accuracy of contour also can be examined, the correctness of lift, and the true points at which lift begins and closing is completed can all be recorded. An attachment to record the angle turned through by the shaft can be added, thus checking up the true lift and closing points. These seldom require to be at any other more precise points than half degrees at the most, and it is only necessary for the dial to show the actual opening and closing points for the various cams on the shaft.

Innumerable gauging jobs can be carried out with these most handy tools, and the gauging department of any engine builders' works would have many of them in service. The writer has seen six in action simultaneously on a relatively simple crankshaft gauging job. The little additional fitments illustrated will prove invaluable in many ways also ; a practical man could make himself a set without much difficulty.

*(To be continued)*

# Clean Screwcutting

**By William R. Burnett**

AFTER one has acquired skill in turning, boring and facing work in the lathe, the important process of cutting screw threads has to be mastered. This particular branch of lathe work often opens up many pitfalls to the " new hand," and a good deal of practice is essential before one may be able to undertake the cutting of a thread satisfactorily on an important piece of work.

Selection of the right change-wheels, in order to give the necessary pitch to the screw is a matter of straightforward calculation and can be readily acquired by a simple system of mathematics. But there is more in it than meshing up the change-wheels and fitting a tool ground to the correct angle in the holder.

Most amateurs experience difficulty in producing a perfectly fitting thread with a smooth clean finish, and more often than not they find that the thread groove is torn and left with an unpleasant jagged or rough surface.

Not only does this detract from the finished appearance of the work, but it also tends to produce a weak thread, and, in the case of one which is to be operated frequently, rapid wear with resultant looseness is sure to follow.

A thread should be perfectly smooth in finish all over, but to secure this result with a single point in the lathe may appear difficult to the uninitiated. If the operator simply takes a cut and feeds in the tool direct on each subsequent cut, a jagged thread is bound to result. The reason being, under these conditions, that one is attempting to cut both sides and the bottom of the groove at the same time. Some amateurs attempt to clean up the thread with a chaser, and others even resort to the use of a three-cornered file, but this is bad practice and cannot be tolerated by any serious-minded engineer.

In order to obtain a satisfactory finish, only one side of a thread should be cut at a time, and by this method it will be found that a smooth and even finish is easily secured. The manner in which this is accomplished is as follows :—

Take one or two ordinary straight cuts with the tool fed in direct. When the thread is getting down to the finished size, bring the top feed back a thou. or two before feeding in for the next cut, so that the right-hand side of the thread only is cut on the next run. Before taking the next cut, turn the top-slide *in* a thou. or so in order that the left-hand side of the thread will be cut.

Continue by this method of alternately feeding the tool from left to right as well as in, when it will be found that the finished thread is perfectly smooth and professional in appearance.

When working on steel, it is, of course, essential that a copious supply of cutting oil is used, and any of the modern branded soluble varieties will be found admirably suited to the work.

# The Novice Dabbles—In Boats

**An account of a newcomer to the model world, who, but for this war and the blackout, might still have been a sceptic in the land of the uninitiated**

**By R. J. Gibbs**

WHEN, at the age of thirteen, I used to row about in Herne Bay, I little guessed I was sowing the seeds of appreciation for ships which have lately blossomed forth.

Even so, if it hadn't been for this war I very much doubt if I should have started building motor launches in the long, dark evenings.

You see, I was staying with a friend, and his house boasted a small workshop and a few—very few, I might add—good tools. (How good they are now and how much he still considers me a "friend" I shall no doubt hear when next he uses them.)

Anyhow, confronted with this retreat and armed with a conscience fomented by a months' old promise of a boat to a very juvenile acquaintance, I decided that my cheerfulness, my courage, my resolution, and so on should be put to the test right here and now.

At the start, I did what I consider the wisest of moves—I bought a really good handbook on model power boats. It put me back six shillings but has certainly been worth it over again. It was, actually, highly technical for me—a very raw novice—and dealt with the scientific rather than the picturesque, but I managed to pick up the hang of displacement and balance sufficiently to base my subsequent work within the limits of practical possibility. I learnt for one thing, a "lazy-man's" rule, that if in doubt (as to stability, I mean) give more beam for safety. Technicians no doubt will scorn my decidedly slip-shod rule but, believe me it plays for safety at any rate!

I met with my first set-back with this handbook adversedly enough, because of its technical teachings. You see, it recommended the accepted methods of hull construction, and, as I had neither the skill nor inclination to plank a carved hull nor sufficient tools to cut my boat from the solid (like shop models), I reverted to an old friend—plywood.

I've no doubt my jobs would meet with many a "tut-tut" at a club-meet, but a low-powered, slow moving launch does not need extra fine lines, and for normal displacement craft, my little fleet prove very pond-worthy.

And besides—I'm still a beginner.

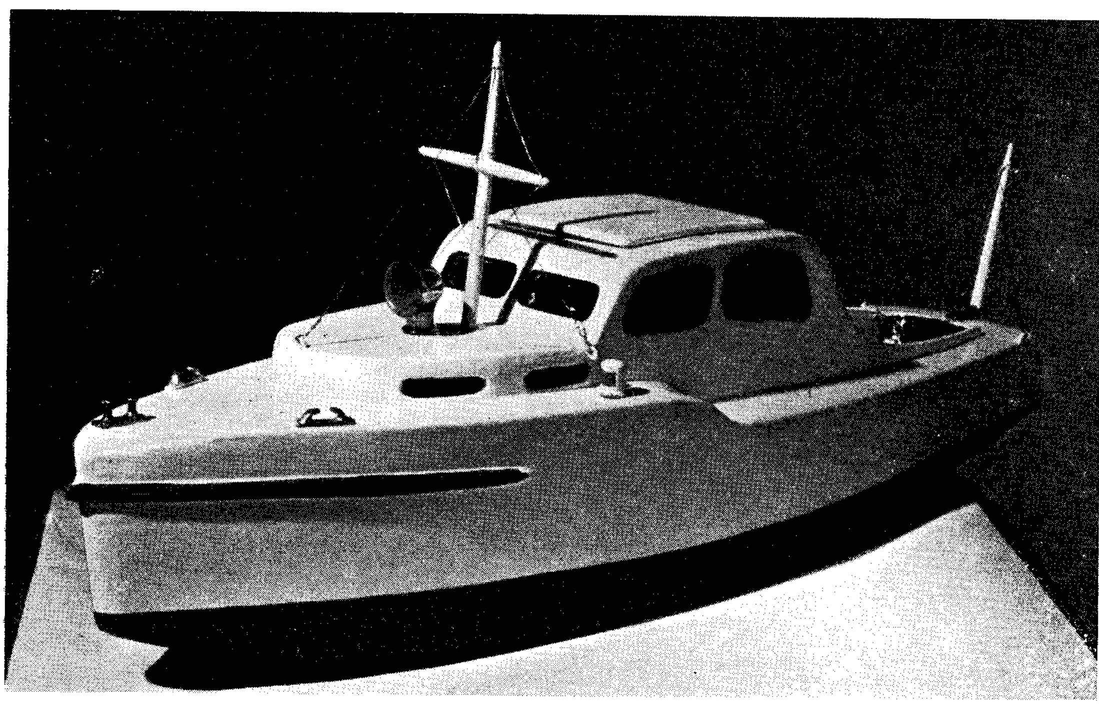


*Photo. by*] [*Leon Isaacs*

**Photo. No. 1—"My first attempt—a clockwork launch."**

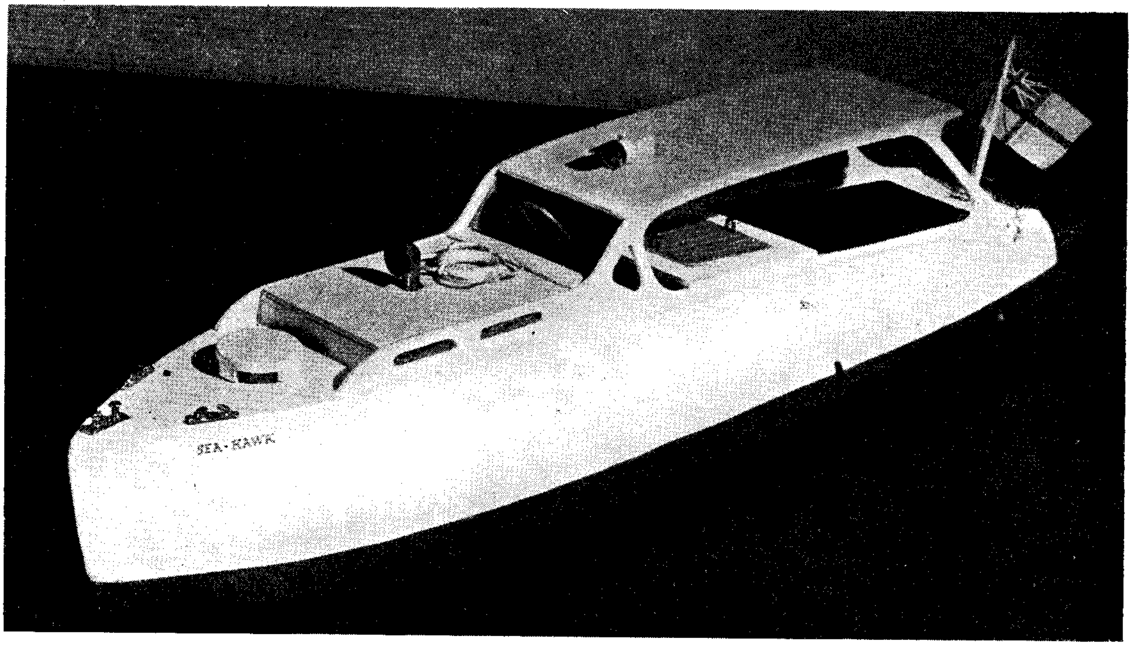



*Photo. by*] **Photo. No. 2—" Sea-Hawk "—this one is electrically driven.** [*Leon Isaacs*

I designed my own boats. For me, it is half the enjoyment. The other half I get seeing them gradually materialise.

My first sketch was something like Fig. 1 and about eighteen inches long. The boat, when built was driven by clockwork and all one had to do was to take the lid off and wind it up about

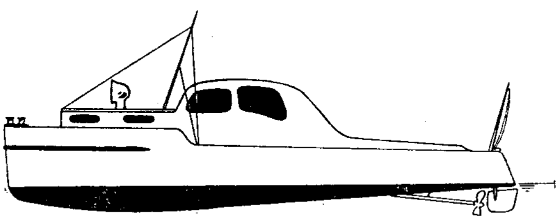


**Fig. 1.**

once every five minutes. I bought the deck fittings quite cheaply and, including the motor and some first class paint, she cost just under eighteen shillings complete. The finished boat is seen in photo No. 1, and flat bottomed or not, you must admit her lines have a decided tendency to be sleek.

Photograph No. 2 shows my second attempt which I built for Bert's nephew. (Bert's the chap I'm staying with by the way.) I planned it on the lines of an American lake launch, and think that the " fly-over " roof, as I fondly term it, more than justifies the work entailed in its construction.

I used electricity for the motive power here, and housed the motor in the cabinet behind the helmsman's seat, but—and here's a warning—leave more space than I did. Wires take up much more room in actuality than on paper, and getting those switches into position after assembly was no picnic !

The second switch, by the way, is for two navigation lights, one on the roof (an adaption of a small brass gas union) and the other a port-starboard housing which was originally a Beecham's pill box. Both were fitted with pea-bulbs and wired in parallel off the same batteries (housed in the fore-cabin) as the motor.

The dash board I cut from a piece of strip brass and scratched a couple of clocks on it with an old pair of dividers, and although the Meccano steering wheel *is* a little large it most certainly adds to the general appearance of *Sea-Hawk I.*

You can't quite see the aft-deck in the photo, but I'd like to explain it with the sketch Fig. 2.

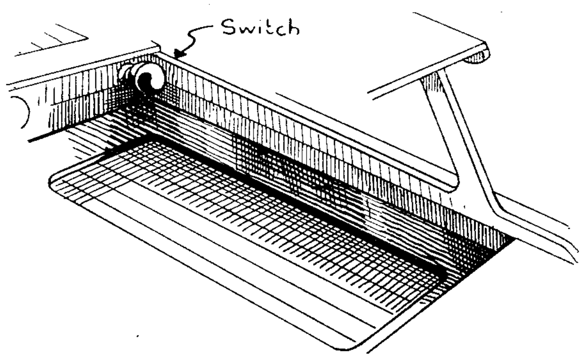



**Fig. 2.**

A seat runs all around the walls (that is to say, along both sides, the stern and the engine cabinet), cut from one piece of mahogany with a knee hole in the centre. The floor of this compartment is scored with the aforesaid dividers to represent

(*Continued on page* 331)

# *"Advice to Beginners!"

**Some hints, based on replies to recent queries, for the assistance of readers who contemplate taking up the construction of model petrol engines**

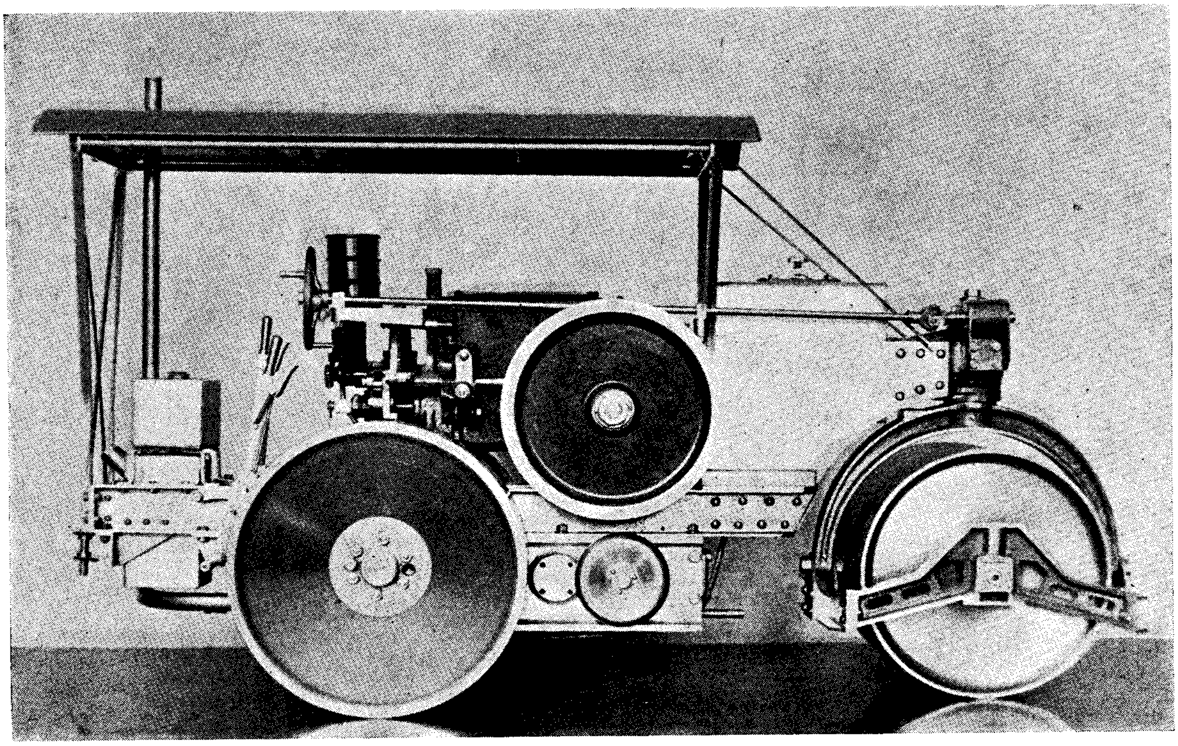
**By Edgar T. Westbury**

MR. L. J. BROUGH, whose unfinished road roller chassis was exhibited in the Loan Section of the 1938 " M.E." Exhibition, was one of the first readers to complete this model, and although I have not personally seen it in its finished condition, I am assured, not only by the constructor but also from independent sources, that it is in every way a most successful model, and never fails to attract attention when demonstrated among local model engineering enthusiasts. The photograph of this model doing a spot of passenger hauling provides ample proof that it is not lacking in efficiency.

The " M.E." road roller was selected for a team effort by an enthusiastic model engineering society, but I have not received news of its progress for some considerable time; this is, perhaps, not to be wondered at in view of the difficult circumstances in which many such societies find themselves at present. I have, however, been keeping in close touch with another very promising piece of team work by two readers, Mr. Ian Bradley, of East Horsley, and Dr. N. S. Hallows, of Marlborough. It is rather interesting to note that when this enterprise was first taken in hand by Mr. Bradley alone, he was, like a good many other readers, interested only in the engine; but no sooner was this completed, than the urge to instal it in its natural habitat became irresistible, and encouraged by the timely assistance of his friend, the chassis soon began to take shape. It is now well advanced, and promises to be an outstanding example of workmanship. Owing to the fact that the partners are working some distance apart, it is necessary to make all the components to close limits of accuracy, and in order to ensure this quite a number of ingenious jigs and gauges have had to be made.

One of the components made by Dr. Hallows is illustrated here, but the photograph fails utterly to convey an adequate impression of the workmanship which has been put into it. Readers may note that the design of the lever does not exactly correspond with that shown in the detail drawing, the main difference consisting in the use of a compression spring on the latch instead of a

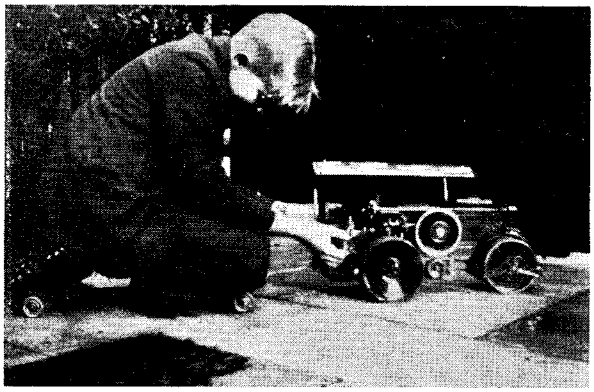
*Continued from page 284, "M.E.," March 21, 1940.



**Offside view of Mr. Ripper's model road roller, in an unfinished condition.**

tension spring attached to the hand grip. As a matter of fact, both types have been used on the prototype at different times, so that one is no more "correct" than the other; the type made by Dr. Hallows is certainly the neater if well carried out, but entails a little more difficulty in construction than the other.

Several readers have shown unusual thoroughness in tackling the construction of this model by



**Mr. L. J. Brough's model road roller doing a spot of passenger hauling.**

making their own patterns to kick off with, and it cannot be denied that the model offers excellent scope for the ability of the amateur patternmaker. One constructor, Mr. Rushton, of Bridport, went still further, and cut all his own gears; this constitutes yet another interesting class of specialised work for which this model offers an outlet. Most of the work in both these branches is of a fairly straightforward nature, with the possible exception of cutting the skew timing gears of the engine, and making the corebox for the engine crankcase.

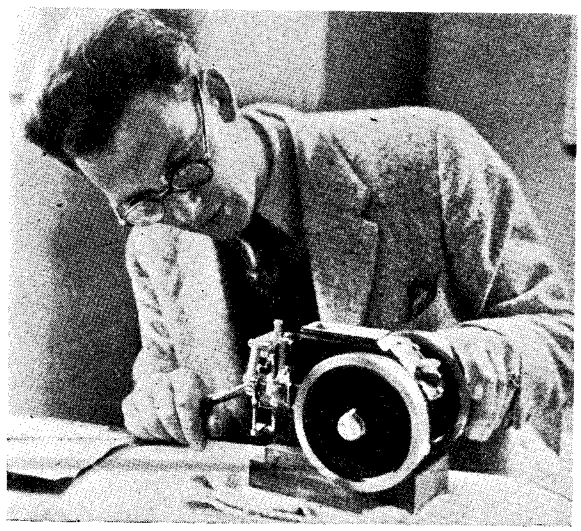
Mr. F. Ford, of Brixton, who is known to many readers as a constructor of model speed boat engines, is among those who have made patterns for this model, and the photographs herewith show not only the pattern and corebox in question, but also the casting produced by them. It will be seen that both pattern and corebox are split—the former for convenience in moulding and the latter by necessity.

Without a single exception, all the readers who have to my knowledge built this engine—many of them with no previous experience of model petrol engine construction—have been able to get it to work successfully, though some of them were very dubious of their ability to do so at the start. Many of them have been agreeably surprised at its efficiency and reliability, while several experienced petrol engine constructors have remarked upon its unusual flexibility and control. It will be remembered that some readers have experienced difficulty with the petrol feed of this engine, and in a previous article I made some suggestions for overcoming this by raising the level of the fuel tank.

Mr. A. J. Every, of Brighton, has fitted a tank adjacent to the side of the engine, and only very slightly below the jet level. The tank on Mr. Ripper's roller is under the driver's seat, in the position which was suggested for the ignition coil. It has been found, however, that the latter can be unobtrusively housed under the footplate, immediately behind the engine, and in this position, the length of the leads is reduced to a minimum.

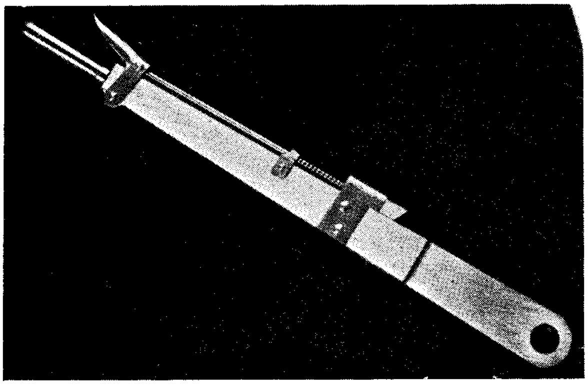
The petrol feed difficulty, however, does not appear to be universally encountered, and some constructors do not experience the least trouble in starting or control with the tank in its normal position at the rear of the chassis, below the footplate level. This constitutes another instance of the fact that no two engines behave in quite the same way, even if built to the same drawings, and there is always some scope for individuality in the adjustment and running of model petrol engines; possibly one of the reasons why this type of model holds such a fascination, in spite of its many disadvantages and bad habits, to which attention is so often drawn by people who "don't 'old wiv 'em."

At this stage, many readers will have come to the conclusion that I have digressed a very long way from the subject of the article, and may quite



**Mr. Ian Bradley with his model road roller engine.**

pardonably ask what on earth this all has to do with "advice to beginners"? It is quite true that some of the readers whose work I have illustrated or discussed do not come into the category of beginners, but it is equally true that they would emphatically disclaim the title of experts. There is no single item of any of these examples of work which could not be carried out successfully by a beginner with an ordinary amount of intelligence, reasonable proficiency in the use of tools and processes, and a lot of patience and determination. The latter qualities are those most commonly found to be lacking in cases where failure has



**A small but excellent specimen of detail work; the brake lever for model road roller, made by Dr. N. S. Hallows.**

occurred; and even then, it is not too late to make a fresh start. Every problem in the construction of these and most other kinds of models has been explained, or at any rate fully discussed, in THE MODEL ENGINEER; and any new problems which may arise are always assured of prompt and sympathetic consideration if submitted to the Queries Department. Neither THE MODEL ENGINEER or any other journal or individual, however, can provide either a substitute for skill or a short cut to it; that part of the problem must be solved individually and alone.

**Criticism of Readers' Designs**

Many readers have sent me drawings of proposed designs, and asked for my opinion as to their practicability, or on points for which certain advantages are claimed. While such advice as I can give on these matters is always at the disposal of readers, it very often happens that many of the details in question are of such a nature that they could only be settled by experiment, and quite a lot of that. It is generally a fallacy to assume that any design which incorporates new or unorthodox features can ever show immediate superiority, or even demonstrate the minor advantages claimed for it beyond all dispute. The line of least resistance, which is generally adopted by the "expert" critic (at whose hands I, myself, have suffered all too often!), is to condemn anything unusual, or to adopt a non-committal "wet blanket" sort of attitude, which is just as bad. Constructive criticism is, however, extremely difficult in such cases, and one is frequently faced with the realisation that it is the lot of the critic to take a choice between popular insincerity and sincere unpopularity. There are so many people

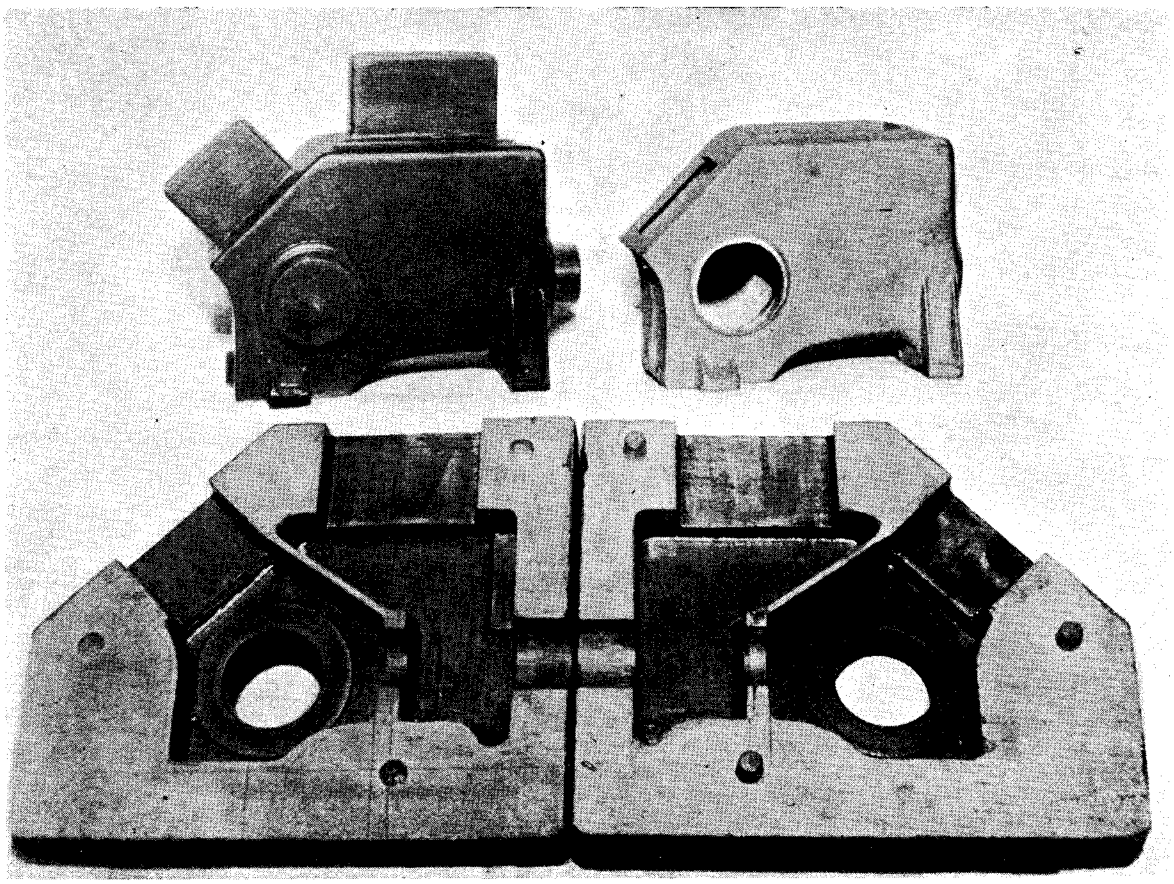


*Photo. by*] **Pattern and corebox for the crankcase of road roller engine, made by Mr. F. Ford, showing also a casting made from same,** [*D. Cheyne*

who will ask for frank criticism, and then take offence when they get it!

I have inspected some examples of design, by comparative beginners, for which I can express nothing but admiration—but purely from the point of design only, and without being able to pronounce judgment on their prospect of practical success. It is, however, a fair assumption that anything that looks right stands a good chance of success; the majority of first efforts in design, however, have something lacking in proportion and balance, and definitely do not " look right." Many readers fail to grasp that one of the fundamental essentials of any engine, or indeed any machine at all, is that it should be sound as a *structure*; it is surprising how often this simple fact is ignored.

Other designers take some rather drastic liberties

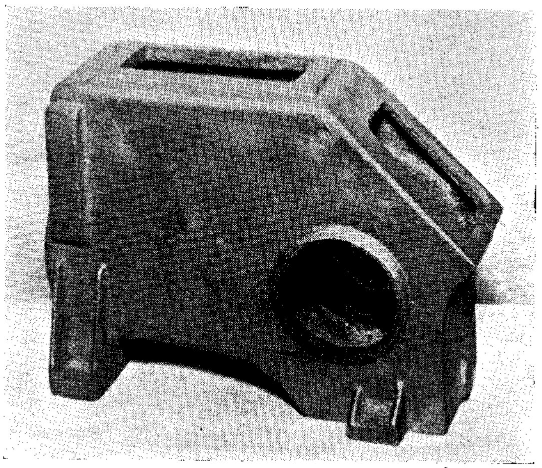


*Photo. by*] [*D. Cheyne*

**A casting made from Mr. Ford's pattern.**

with simple principles of mechanics; bearings without visible means of support, impossible angles of thrust, and components which either could not be assembled at all, or would not work without fouling other components, are all too common. One engine design, which was good in other respects, had a connecting-rod which would have inevitably been sheared through by the crank regularly once per revolution! Another engine, which was actually finished and made to work (though, for obvious reasons, not too successfully) had radial valves at 90° to each other, operated by vertical push-rods and straight horizontally pivoted rockers.

These faults are all avoidable by proper setting out on the drawing board, and are really inexcusable. Simple geometry will give the exact paths of all working parts, including valves and cams, though it is admitted that some of the more advanced problems in the motions of such parts are by no means so easy of solution.

One reader had a scheme, which he believed to be original, for operating inlet and exhaust valves by means of eccentrics instead of the usual cams, and claimed many important advantages for it. Quite apart from the fact that his drawings embodied a very serious fundamental mechanical error—the eccentrics were timed to run at *twice* engine speed instead of one-half!—the method, while practical up to a point, is certainly not advantageous, neither is it by any means new. The early Gardner horizontal gas engines had eccentric-operated valves, and were very successful within their limits of speed and performance; some of them are still working at the present day.

It is perfectly true to say that an eccentric or a crank will provide truly harmonic reciprocating motion—but only if the full cycle, or complete double stroke, is utilised. This cannot be done in the case under discussion, unless the eccentric is intermittently operated, because the opening period of either valve is never more than about one-third of the full engine cycle. It would thus be possible to use only one-third of the eccentric stroke; allowing lost motion, or "tappet clearance" equal to the other two-thirds.

The result of this would be that instead of the valve itself (which is the part that matters) being opened and closed harmonically (i.e., with smooth acceleration and deceleration), it would receive a hammer blow from the eccentric gear, which would actually be decelerating at the time the valve would have to accelerate; and the reverse state of things would occur in lowering the valve on to its seat, thus increasing risk of valve bounce. It will thus be obvious that at really high speed the valve action would be so fierce as to hammer itself rapidly to destruction.

### *Festina Lente*

Talking of destruction, I am reminded that this applies also to my criticisms, or at least those I have recounted here. But constructive advice is often so prosaic and unromantic as to leave little to talk about which would interest readers in general. Often it boils down to a reiteration of what I have said earlier in this article: the beginner will generally find it more profitable to gain experience by working on a well-tried design, than to attempt to work out everything for himself right away. It is, perhaps, characteristic of modern tendencies that everyone is out for quick results; the old idea of starting at the bottom of the ladder and working slowly and steadily towards the top is regarded as " just too quaint." I am sufficiently old-fashioned to favour the latter mode of progress, however, and while I have every sympathy with the enthusiastic novice who wishes to build a speed boat engine, for instance, which will break world's records, I am not too optimistic about his chances of doing so with the first engine he constructs. Admittedly, meteoric success is not altogether uncommon, but most of us find that even the smallest successes have to be fought for very strenuously; and, therefore, as a parting injunction to the beginner, I add this well-tried piece of advice: *Festina lente*—or, in plain English, " Hasten slowly "!

# Practical Letters

### "Fresh Ideas"

DEAR SIR,—"Adage" has hit the nail on the head with his article. Model-making has arrived at a state of coma where nothing really new is produced. Although some of the suggestions he makes may not be to everyone's taste, there is a good deal of truth in what he says.

We, as model makers, are very conservative in our ideas, and this is illustrated by the letter from "Clack Valve" who takes umbrage at the underlying idea of the article.

"Adage" makes some very useful suggestions, and a number of models of something new, based on his remarks, would be very welcome and instructive, *especially* for historical purposes.

Yours faithfully,

London, S.E.23. M. PICKERING.

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DEAR SIR,—The letters published in your admirable journal over the signatures of "Adage" and "Clack Valve" raise certain interesting points.

The assertion of the latter gentleman that your readers, in remaining true to their own individual model-engineering "loves," are consequently unable to interest themselves in an article on another and perhaps widely different type of machine, seems to call for comment. Take for example the body of readers who are primarily, like myself, interested in model locomotives; is it suggested that after reading the "Smoke Rings," the articles by Mr. Lake, "L.B.S.C." or Mr. Keiller, and such letters as may directly concern our own work, we simply file the paper for future reference? I maintain that, on the contrary, it is the very diversity of interests catered for by the new MODEL ENGINEER that gives the paper its charm.

Personally, I would like to see more articles on larger scale models—both locomotives and other classes. And incidently, may I plead for something really up to date on stationary steam engines? But that is a digression. I wonder how many readers (whatever their speciality) did not take pleasure in the admirable articles from the pen of Mr. Gentry, describing the "Midge" loco.? Likewise, Mr. Westbury's series on the MODEL ENGINEER Road Roller? There must, surely, be no inconsiderable proportion of readers who take delight in the contemplation of the work of others, or even merely like to savour the aesthetic joys of literature, particularly if this is applied to small-scale engineering and illustrated by good drawings.

I apologise for the length of this epistle, and I take this opportunity of wishing you all the best for 1940.

Yours faithfully,

"SERVING SOLDIER."

[Judging from the great majority of letters we have received from readers who are kind enough to offer comments upon THE MODEL ENGINEER, it *is* the wide variety of subjects catered for that appeals to a great many. It would seem that most model engineers take a delight in reading a well-written description of a model of *any* kind, especially when drawings and photographs accompany the description. And while, just at the present time, we are devoting some considerable space to instructive articles dealing with the use and application of machine tools to national needs—a policy that seems to be fully justified by the approval expressed by amateur craftsmen all over the country—we intend to continue with our efforts to provide for the leisure-hour interests of model engineers generally.—Ed., "M.E."]

### A Track-making Query

DEAR SIR,—I possess an 11/16 in. scale railway myself; I have learnt many things from the letters of the "wise" readers, and from articles by "L.B.S.C.", but there is one thing left to be learnt, and that is how can one make a track in wartime. I lay my track in 12 ft. lengths, and the sleepers were 1 in. × $\frac{3}{4}$ in. × 6 in., with battens. As I am working on some timber cutting, I was wondering whether it would help to saw out some straight oak sections. How can I do away with battens and yet retain a rigid track? Would my sawing skill (very poor!) give me good enough sleepers? I should be very thankful, and I expect other people would be also, if one of the "wise" readers would answer for me and all the model railway engineers who are in the same "hole."

Yours faithfully,

Godalming. G. WHYTE-VENABLES.

# The Novice Dabbles—In Boats

(*Continued from page* 326)

boards, and given a coat of varnish. The contrast effected by mahogany seats, varnished decks, and cream and green hull, looked really stunning, and I added another attempt at realism by binding an old curtain ring with insulating tape and painting it to represent a life-belt. She measures about two feet long and has a displacement of some three pounds. The cost is I think quite reasonable, being in all twenty-five shillings.

I suppose it was quite natural that having passed through the clockwork and electric-driven stages I should turn to steam, and so when asked by a pal to build a craft for his youngster, I went ambitious and designed what is described, I think, as a motor yacht. I submitted my plans to him in the approved manner of the contractor and got permission to spend up to fifty shillings on a "really good-looking job" as he put it.

I intend to deal fully with this boat. The method of building which I employed I will expose in its entirety, and also how I spent the money in turning out a boat which, although I say it, is certainly a peach!

(*To be continued*)